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THE NAVEL ORANGE OF BAHIA; WITH NOTES ON
SOME LITTLE-KNOWN BRAZILIAN FRUITS.

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CONTENTS.

	Page.		Page.
Introduction.....	1	Citrus fruits of the region around Rio de Janeiro.....	16
Origin and history of the navel orange of Bahia.....	1	Miscellaneous fruits grown at Bahia.....	17
Introduction of the Washington Navel orange of Bahia into the United States.....	4	Some interesting fruits of Rio de Janeiro and vicinity.....	25
Culture of the navel orange in Bahia.....	7	Fruits of the highlands and semiarid regions of Minas Geraes and Bahia.....	31
Citrus fruits of Bahia other than the navel orange.....	15		

INTRODUCTION.

Since the introduction of the Washington Navel orange from Brazil 45 years ago, its culture in California has been continually extended, until to-day the industry produces an annual income of something like 30 millions of dollars. Yet, in spite of the importance of this fruit, little has been known in the United States of its history in its native home, Brazil, or of the methods and practices of Brazilian orange growers.

ORIGIN AND HISTORY OF THE NAVEL ORANGE OF BAHIA.

Unfortunately, the origin of this remarkable fruit is somewhat obscure, and the only available accounts are those which have been handed down from father to son and are still preserved among a few of the Brazilian orchardists. It is the general belief among the latter that the navel orange came into existence at Bahia in the early part of the nineteenth century. It is believed to have been first propagated by a Portuguese who lived at Cabulla, a suburb of Bahia City. This section is at the present day the most important

orange-growing district of Bahia (Pl. I), though most of its commercial plantations do not date back more than 40 or 45 years. The name of the originator does not appear to be known at the present day, or the exact location of the property on which the variety originated. Only the most fragmentary accounts are given by the orange growers, who should and probably do know more about the subject than most others. The most complete and probably the most accurate statement is that furnished by the Rev. W. A. Waddell, a Presbyterian missionary, who has lived for years in the vicinity of Bahia and has been much interested in this subject, as follows:

Twenty years ago an old man, a very intelligent cabinetmaker, told me that in his youth, before the independence of Brazil, the *laranja de umbigo* (navel orange) was found only in some groves in Cabulla. He, as a boy soldier, in company with his comrades, "chupou muitas" (ate many) during the siege of Bahia, being stationed in a grove that contained some trees. Most of his comrades had never seen them before, but he had seen them sold by the slaves of a Portuguese. He had heard that a "mandinga" woman charmed a seed and made the first tree yield "umbigoed" fruit. This was information gathered when he was young, say, 1816 or 1818. I came to the conclusion that the seedling tree originated in Cabulla in 1810-1820, or perhaps even earlier, and was first propagated by a Portuguese grower, and that in 1822, the year of Brazilian independence, there was quite a lot of trees. Of course, the production of any odd-shaped fruit would be explained by fetichism among the lower classes.

It will be noted that Dr. Waddell speaks of the "seedling tree" which originated in Cabulla. All the evidence, however, indicates that the variety originated as a sport, or mutation, upon a *Selecta* orange tree, *laranja selecta*, as it is known in Brazil. The *Selecta* is almost identical with the navel orange in many characters and frequently shows a marked tendency to produce navel fruits, even though it is normally without any vestige of a navel. The Bahians themselves recognize the similarity between these two varieties and call the navel orange "*Selecta de umbigo*," or navel *Selecta*. This name may, in fact, have been given to the first navel tree to indicate its origin.

The *Selecta* orange, while rarely seen at Bahia, is still cultivated commercially in the vicinity of Rio de Janeiro, especially at Sao Gonçalo, a suburb of Nitheroy. In one of the groves of this section, that of Joao Elias Esteres, the presence of occasional fruits with well-defined navels was observed on trees which normally produced typical *Selecta* fruits. The navels in these fruits were in some cases as large and well developed as in the typical navel orange, although they did not protrude through an opening in the apical end of the fruit as commonly as in the latter variety.

The typical *Selecta* orange (Pl. II) is slightly oblate in form and contains 15 to 20 seeds. In bud-sport fruits with navels (Pl. III),

the form tends to become more nearly that of the navel orange, i. e., spherical, and the number of seeds was reduced to an average of nine in the specimens examined.

When all the evidence is considered, there is scarcely any room left for doubt concerning the origin of the navel orange of Bahia as a sport from the Selecta variety. Other accounts obtained at Bahia substantiate the belief of Dr. Waddell that the variety originated in the Cabulla district during the first or second decades of the nineteenth century.

The origin of the Selecta orange is even more obscure than that of the Bahia navel. It has been known in Brazil since a remote date, and in all probability was brought there by the Portuguese from the Iberian Peninsula, though it might have come through one of the Portuguese settlements in the Orient. An article which appeared in "The Garden" and is quoted in the report of the United States Department of Agriculture for 1877 mentions it as occurring in the Azores, with the note that it is "large, of first-rate flavor, little acidity, and of deep yellow color. It has scarcely any pips and does not ripen until April, which gives it a higher value." In Rio de Janeiro it is preferred by many to the navel orange; in fact, it is classed by some as the best orange in Brazil. Its fine quality at Rio de Janeiro may be due in some measure, however, to the effect of climate or soil.

The extension of the navel-orange industry in Bahia, which has resulted in the present large groves of Cabulla, Matatu, and other districts near the city of Bahia, has taken place since 1860 or 1870, according to the statements of the oldest orchardists. This is about the time of the introduction of the variety into the United States. Previous to that time there were only a few small groves in the Cabulla district. A census taken in 1913 by Dr. V. A. Argollo Ferrão showed that there were in the territory immediately adjacent to the city of Bahia about 67,000 trees, and about 6,000 more in small plantations in the interior of the State, notably at Matto de Sao Joao, Santo Antonio de Jesus, Amargosa, and Bom Fim, making a total of 73,000 trees. The principal orange districts within the municipality, as shown upon the map (p. 8), are as follows: Cabulla, containing about 30,000 trees; Saboeiro, with 12,000 trees; Cruz do Cosme, 7,000 trees; Matatu, 8,500 trees; Brotas, 6,000 trees; Sao Gonçalo, 2,000 trees; and Victoria (including Barra, Graça, and Rio Vermelho), 1,500 trees. As there are usually about 100 trees to the acre, the total acreage in oranges within the State is approximately 730. About one-third of the total number of trees have been planted less than three years; one-third are from 3 to 6 years of age, and the remaining third, 6 to 40 years of age.

At the present time nearly the entire crop is consumed locally. While small shipments are made to Rio de Janeiro and the steamers which call at Bahia usually take on oranges for use on board, an established trade has not been developed. Yet new orchards are being planted every year and the growers seem to be awakening to the possibility of developing a vastly larger and more profitable industry, with the hope of building up an export trade which will include not only Europe but eventually the United States as well. Because of superior transportation facilities, the European markets are likely to be entered first. In the past the high cost of transportation, crude methods of packing and handling, and other factors have prohibited exportation to distant countries. With fast steamers and the introduction of modern methods of packing and shipping there seems no reason why Bahia should not enter the export field.

The cultivation of this variety in Brazil is not limited to the State of Bahia. It has been planted in other parts of the Republic, but in nearly all cases less extensively than at Bahia itself. Commercial orchards are said to exist in the States of Sao Paulo and Rio Grande do Sul. In orchards around Rio de Janeiro the variety is very rarely grown.

INTRODUCTION OF THE WASHINGTON NAVEL ORANGE OF BAHIA INTO THE UNITED STATES.

The United States owes the successful introduction of the navel orange to the late William Saunders, Horticulturist, Landscape Gardener, and Superintendent of Gardens and Grounds of the United States Department of Agriculture. It is not certain, however, that the trees which were introduced by Mr. Saunders were the first which had been brought to the United States, though they were the first to come into successful bearing. The late Thomas Hogg, of New York, in an account published in 1888, stated that about 1838 a wealthy Scotch planter in Brazil determined to manumit his slaves and remove with them to the United States. He settled on an island in middle or southern Florida and then returned to Brazil and secured a collection of plants for introduction, which he consigned to Mr. Hogg, who at that time conducted a nursery at the corner of Broadway and Twenty-third Street, New York. Among these plants were several navel-orange trees. After the plants had been held in a greenhouse for a year, in order to allow them to recover from the effects of the long sea voyage which they had undergone, they were forwarded to the owner in Florida. During the Seminole War the owner was charged with giving aid and comfort to the enemy, and the entire collection of plants was destroyed by the United States troops. The owner then moved to Haiti.

While it can not be positively stated that these trees were of the same variety as that subsequently introduced by the United States Department of Agriculture, it seems probable that this was the case. None of the trees survived long enough to come into fruit, however, and no trace of them now exists.

In a private notebook of Mr. Saunders, now in the possession of his daughter, Miss Belle C. Saunders, is to be found the following entry:

DECEMBER 20, 1898.

I propose to note from time to time some reminiscences of persons and things. Also make mention of such items as I desire to establish as worthy of record in my practice, items that have been more or less of value in horticultural and kindred pursuits.

WILLIAM SAUNDERS.

This note indicates that Mr. Saunders wrote the following unpublished account (appearing in that notebook) of the successful introduction of the navel orange some time between December 20, 1898, and the date of his death, September 11, 1900:

Some time in 1869 the then commissioner of agriculture, Horace Capron, brought to my office and read to me a letter which he had just received from a correspondent at Bahia, Brazil. Among other matters, special mention was made of a fine seedless orange of large size and fine flavor. Thinking that it might be of value in this country, I noted the address of the writer and sent a letter asking to be the recipient of a few plants of this orange. This request brought, in course of time, a small box of orange twigs, utterly dry and useless. I immediately sent a letter requesting that some one be employed to graft a few trees on young stocks and that all expenses would be paid by the department. Ultimately a box arrived containing 12 newly budded trees, and, being packed as I had suggested, were found to be in fairly good condition. I believe that two of them failed to grow. No expenses were charged, so I presume that the correspondent sent them as a gift. All that I ever knew about the donor was that she was a lady, and that the correspondence, so far as she was concerned, was not official.

I had a supply of young orange stocks on hand, and as fast as I could secure buds they were inserted on these stocks. The first two young plants that were sent out were sent to a Mrs. Tibbetts, Riverside, Cal. That lady called here and was anxious to get some of these plants for her place, and I sent two of them by mail. They prospered with her, and when they fruited attention was directed to their size and fine appearance, and when ripe their excellence was acknowledged, and the fruit was called Riverside Navel, thus ignoring the label attached to the plants, which was Bahia, a very distinctive name, which should have been retained. Afterwards other Californians, not wishing Riverside to be boomed with the name, changed it to Washington Navel, all of which was uncalled for, but this department could not alter it, and it was considered best to adopt the name and so avoid further confusion.

We budded many hundred from time to time and sent them to Florida, where it has never become very popular, owing to its not bearing plentifully. I have seen trees 15 feet in height, fine trees, at Rockledge with not over a couple of dozen fruits on them. Why it fruits better in California than it does in Florida is not known. In the orange house of the department it has never

fruited heavily, but is most profuse in flowers. It was thought that the original trees were not all of one kind and that those sent to Florida were different varieties. This was a mistake, as all were fruited here and all were alike. * * * Many thousands of acres have been planted and upward of 2,000 carloads of fruit have been transported to the East in one year. It has also been received with favor in the English market, some sent to London having brought good prices. It has proved to be, perhaps, the most valuable introduction ever made by the Department of Agriculture in the way of fruits.

Some years ago Rev. W. A. Waddell, already referred to in connection with the origin of the navel orange, was in Riverside, Cal., and saw the two original trees which were sent by Mr. Saunders to Mrs. Tibbetts. Becoming interested in their history, he made inquiries of some of his associates when he returned to Bahia, and was told by the Rev. F. I. C. Schneider, the first Presbyterian missionary to Bahia, that he was the one who had secured and packed the trees which were sent to the United States in 1870. Mr. Schneider, who died about three years ago, told of an earlier shipment that had been sent to the United States, but word was sent back that the trees had all perished during the voyage. Some one requested Mr. Schneider to prepare a shipment as carefully as possible, and he did so.

Several old friends of Mr. Schneider were interviewed in Bahia, to see if any account of this shipment could be obtained. One of them, Carlotta da Boa Morte, whose mother was a servant in the Schneider household, clearly recalled the incident. She stated that while she was yet a girl and was living with her mother at the Schneider home Mr. Schneider one day took the family for a picnic to Engenho Velho, a large farm in the suburbs of Bahia, owned by Sr. Teixeira. They spent the day there, and before they returned to town Sr. Teixeira brought in a number of navel-orange trees, and also a few of the lima doce, or sweet lime, which he packed in boxes and sent to Mr. Schneider's house in the city. Here, after long discussion of the best method of packing them to withstand the trying voyage which was before them, they were placed in a wooden crate and dispatched to the United States.

The fazenda (farm) of Engenho Velho, where the trees were obtained, has been divided in recent years, but a portion of it still remains in the possession of Sr. Teixeira's son. A number of old orange trees, uncared for and in bad condition, are still growing on the property. Some of these may have been the parents of the young plants which were sent to North America. The younger Teixeira states that the orchard was planted originally with budded trees from the grove of Sr. Barro Reis, in Cabulla, but he knows nothing about the young trees supplied to Mr. Schneider.

CULTURE OF THE NAVEL ORANGE IN BAHIA.

CLIMATE.

The climate of Bahia is warm and humid, with more or less well-defined wet and dry seasons, the wet season beginning in February or March and lasting until June or July, when the dry season normally commences and continues until the following January. The rainfall is not, however, limited to the wet season, although it is much heavier at that time than during the remainder of the year. The size of the orange crop and the quality of the fruit are said by the orchardists to be affected materially by the amount of rainfall, the largest crops and the best fruit being produced when the rains are unusually heavy.

The annual precipitation for the last nine years has varied from 40 to 73.35 inches, both these extremes being unusual; ordinarily there is a rainfall of 55 to 65 inches. The temperature of this region is more or less uniform throughout the year and comparatively constant during the entire 24 hours. Frost is unheard of, the lowest recorded temperature during the last nine years being 63° F. The highest temperature for the same period is 101° and the mean temperature 76.4° F. From January to June the mean temperature usually ranges from 75° to 80° F.; from June to September there is a slight drop, the average being 72° to 75° F. October, November, and December are slightly warmer, varying from 77° to 80° F. These figures are based upon data obtained at the State meteorological station, near the city of Bahia (Table I).

TABLE I.—Temperature and precipitation at Bahia, Brazil, 1904 to 1912, inclusive.

Year.	Temperature (° F.).			Total precipitation.	Year.	Temperature (° F.).			Total precipitation.
	Maximum.	Minimum.	Mean.			Maximum.	Minimum.	Mean.	
1904.....	101	64	76	<i>Inches.</i> 59.1	1909.....	93	66	76	<i>Inches.</i> 59.4
1905.....	91	64	76	67.5	1910.....	92	66	76	63.5
1906.....	95	63	76	62.25	1911.....	92	67	77	73.35
1907.....	92	63	76	40.0	1912.....	95	67	77	71.9
1908.....	92	64	78	56.5					

SITUATION OF THE ORANGE ORCHARDS AND THE SOIL CONDITIONS.

The land in the immediate vicinity of Bahia is, for the most part, a series of low, rambling hills, not over 100 or 200 feet in height, with intervening level valleys where the soil is frequently wet and best suited to the cultivation of such plants as Angola grass (*Panicum barbinode* Trin.), an important forage crop both for horses and for

cattle. Practically all of the orange groves are located on the hill-tops (fig. 1 and Pl. IV), frequently extending down the hillsides to the borders of the valleys. As terracing is not practiced, the hillside soil is sometimes badly eroded.

The surface soil on the hilltops is usually a rather coarse, sandy loam a foot or more in depth, underlain by the heavy, yellowish red clay which is characteristic of the region. On the hillsides, which are subject to erosion by the rains, the surface loam is lacking. The clay

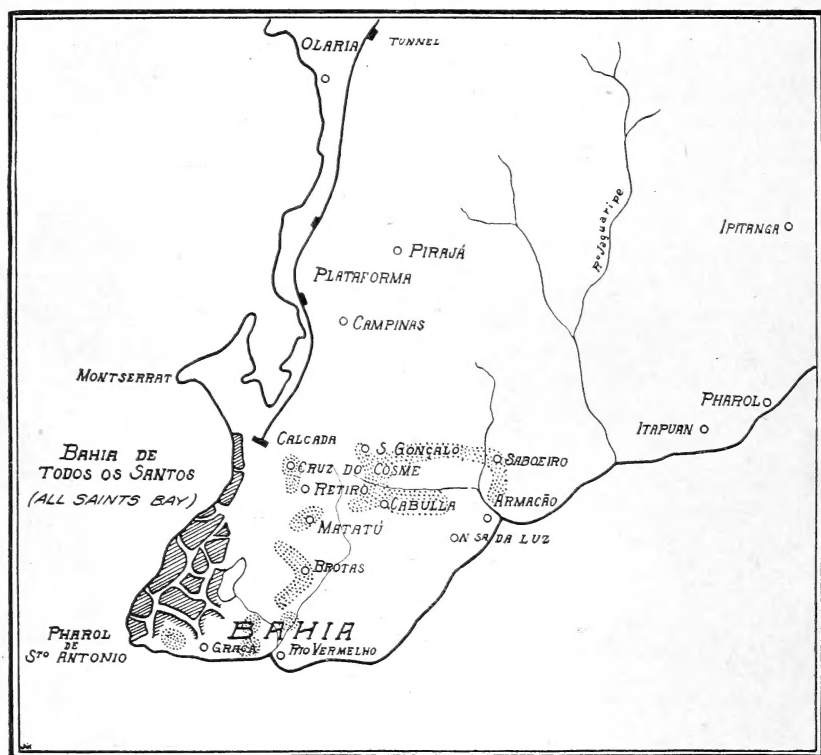
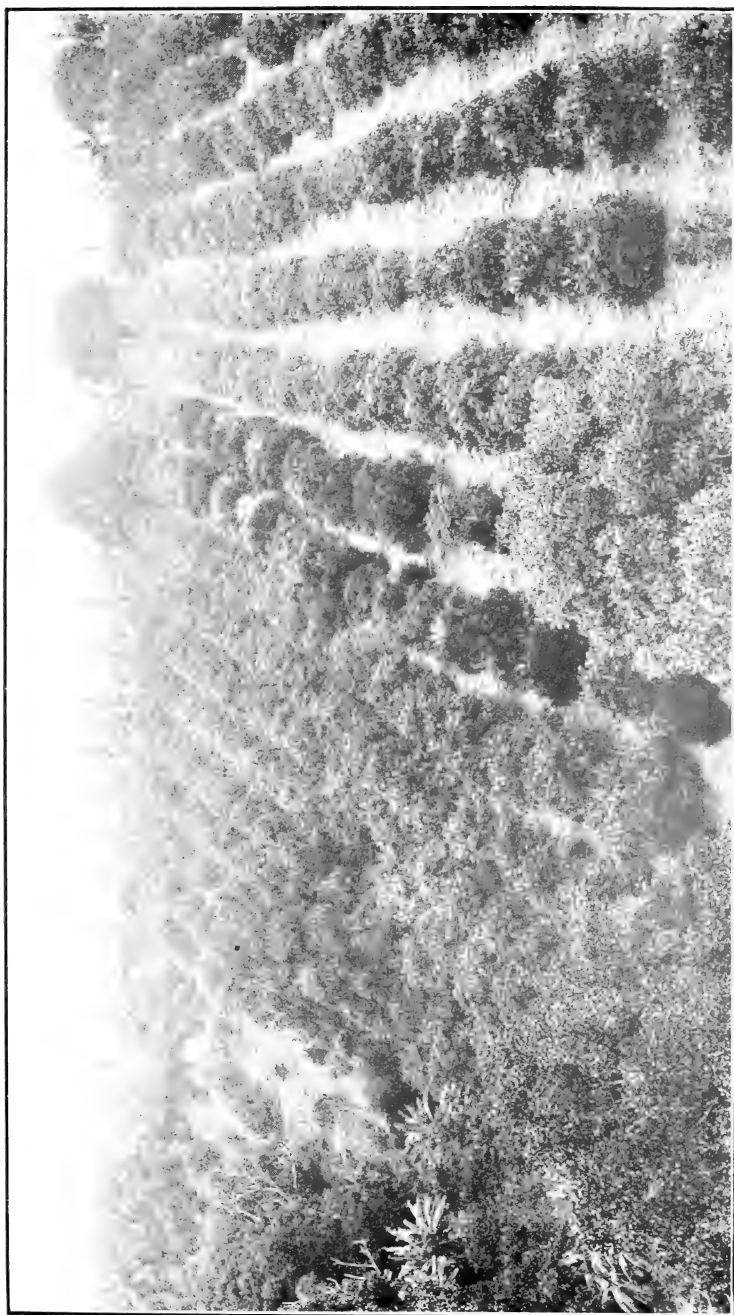


FIG. 1.—Sketch map of the vicinity of Bahia, Brazil, the dotted areas showing the principal districts where navel oranges are grown.

soil, though occasionally shallow, frequently extends to a depth of 30 feet or more, as shown by numerous railway and road cuts in the region. It commonly rests on granite.

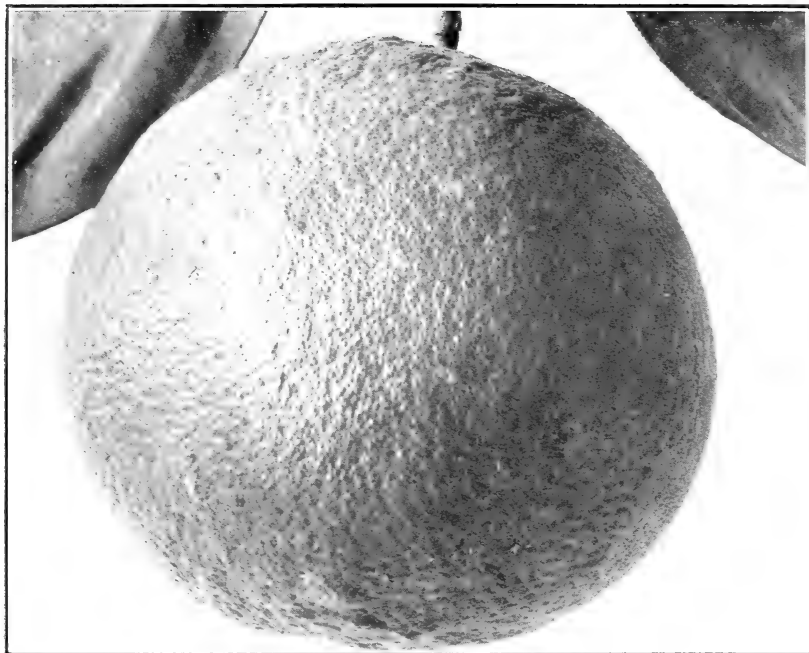
Before clearing, the land is covered with shrubby vegetation, nicurí palms (*Cocos coronata* Mart.), mangabeiras (*Hancornia speciosa* Gomez), and sometimes virgin forest. The presence of the mangabeira is taken as an indication that the land is suitable for orange culture. The municipality of Bahia includes about 50,000 acres of arable land, of which it is claimed about 35,000 acres are typical citrus soil.



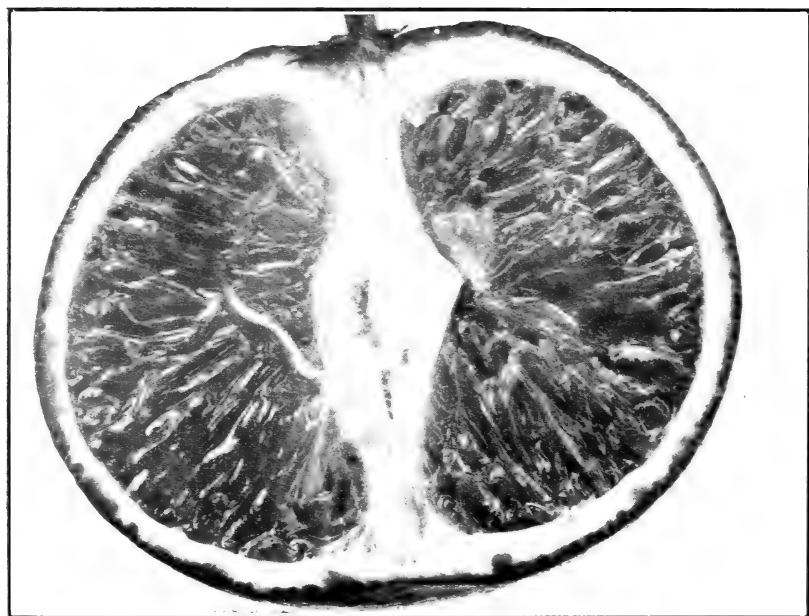
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A NAVEL-ORANGE ORCHARD IN BAHIA, BRAZIL.

A portion of the orange grove of Col. Lago, at Caballa, near the city of Bahia, one of the largest groves in Bahia State, containing about 9,000 trees. Those with dark-colored foliage in the central rows are tangerines. Hillsides land is nearly always selected for orchards in this region. It is cleaned of weeds but not cultivated deeply before or after planting. Photographed December 12, 1913.



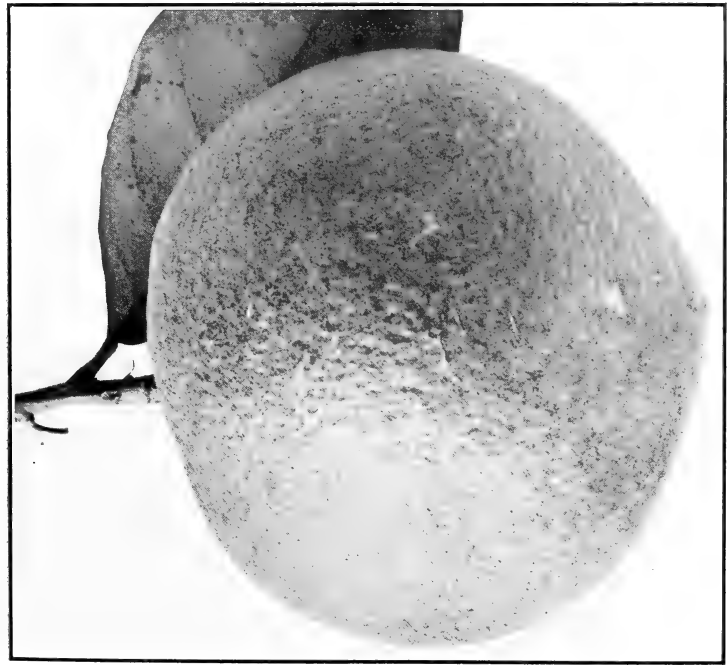
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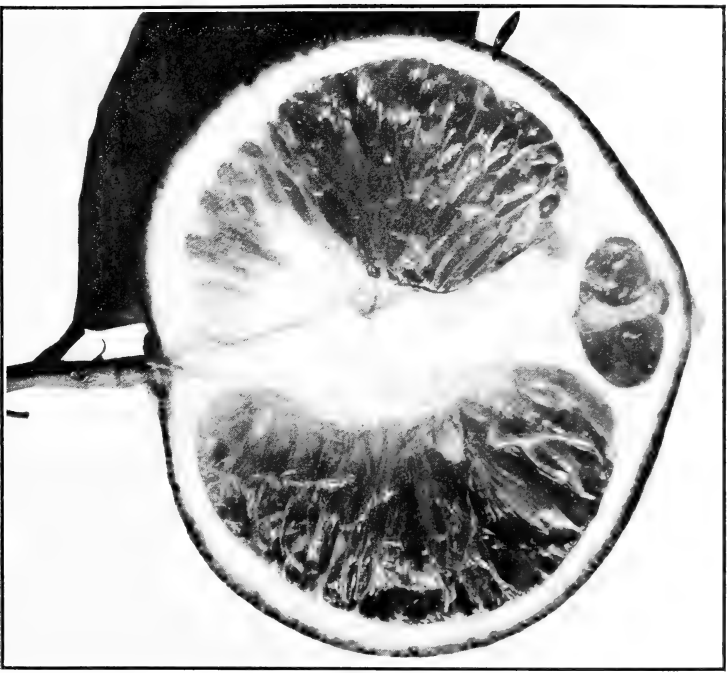
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A TYPICAL FRUIT OF THE SELECTA ORANGE AND A LONGITUDINAL SECTION OF THE SAME.

While normally of the shape shown and devoid of any vestige of a navel, the variety occasionally produces fruits with internal or even externally prominent navels, resembling in every way those of the Bahia or true navel orange. This and other evidence indicates that the Bahia navel originated as a sport or mutation from the Selecta orange, a variety which has been cultivated in Brazil since a remote date and is grown commercially near Rio de Janeiro. Photographed at Rio de Janeiro, Brazil, March 20 and 23, 1914. (Natural size.)



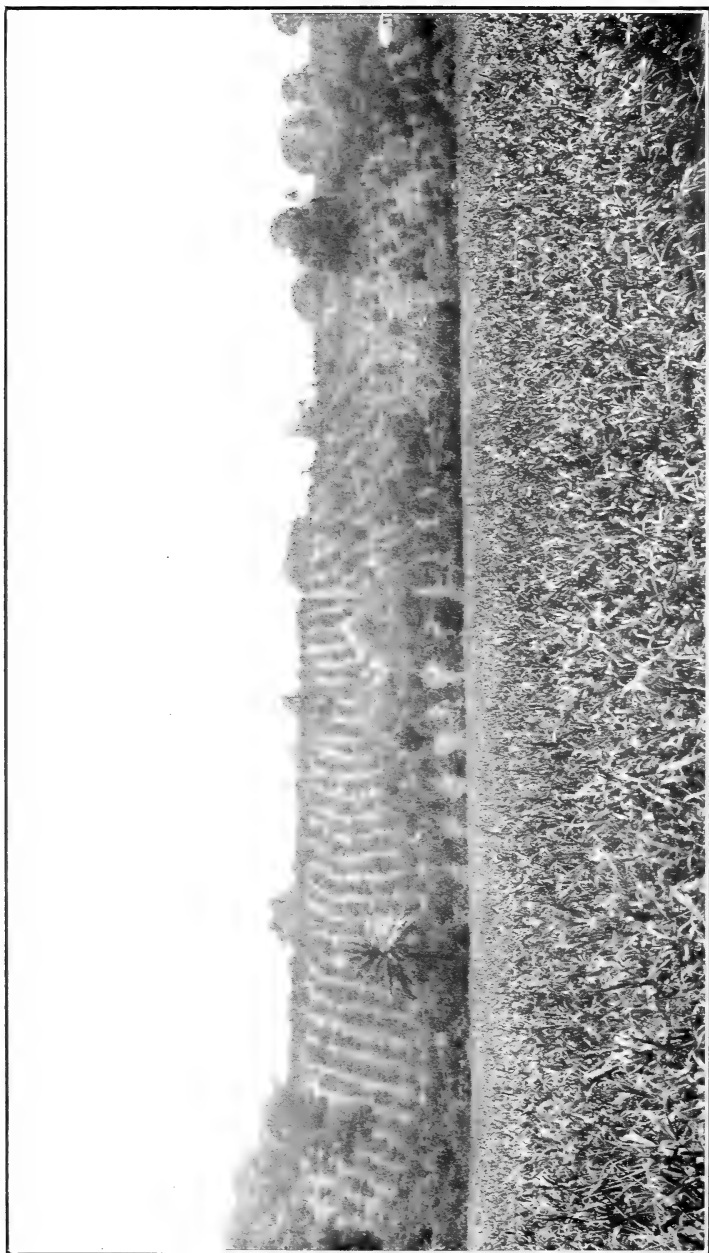
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A BUD-SPORT FRUIT AND A LONGITUDINAL SECTION OF THE SAME FROM A SELECTA ORANGE TREE IN THE GROVE OF SR. JOÃO ELIAS ESTERES, NICTHEROY, BRAZIL.

Most of the fruits on the trees in this grove were normal in type, resembling those shown in Plate II. A few were found, however, which departed from the normal and were swollen at the apex, indicating the presence of an internal navel, like that shown above. In a few other bud-sport fruits found upon Selecta trees the navels were as prominent externally as in the average Bahia navel orange. Photographed at Rio de Janeiro, Brazil, March 20, 1914. (Natural size.)



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A NAVEL-ORANGE ORCHARD ON A HILLSIDE NEAR BAHIA, BRAZIL.

Most of the orange orchards in the vicinity of Bahia are planted on hillsides; the soil being a heavy reddish clay. This illustration shows a portion of the Barretto orchard, one of the principal ones of the Cabula district. In the foreground is a field of Angola grass (*Panicum barbinode*), which is exclusively grown as a green forage crop. Photographed December 13, 1913.

PROPAGATION AND STOCKS USED FOR THE NAVEL ORANGE.

Shield budding, essentially the same as practiced in the United States but differing in a few minor details, is the method used for propagating the navel orange in Bahia. Seedlings of laranja da terra (*Citrus aurantium* L.), the bitter or sour orange, are practically always employed as stock plants. The chief reason for the almost exclusive use of this stock seems to lie in the fact that it is more easily budded than others. Laranja da china (*Citrus sinensis* (L.) Osb.), which is sometimes used, is objected to in Brazil because of its thorniness, and also because it does not heal well around the bud and is apt to die back when it is cut off after the bud has started into growth. Very little is known of the comparative effect of these two stocks on the scion, but some of the orchardists in Rio de Janeiro, where both these stocks are used, hold that laranja da china produces a longer lived tree than laranja da terra.

Seeds of laranja da terra are sown in beds or rows, preferably on high, well-drained, sandy land. When the seedlings have attained a height of about 6 inches they are either transplanted to nursery rows about 3 feet apart, setting the plants about 12 inches apart in the row, or they are transferred to the place the budded trees are to occupy permanently in the new orchard and later budded in situ. The orchardists give as a reason for this latter practice that it produces hardier trees and that the trees come into bearing sooner than those transplanted from the nursery after budding.

When the seedlings are 1 to 2 years old they are budded, no care being used in the selection of bud sticks, as a rule, other than to cut thrifty water sprouts from large and vigorous trees. Budding is usually done in the dry season; buds cut in the shape of a shield three-fourths of an inch to an inch and a half in length are inserted in the stocks 15 to 20 inches above the ground. The bud sticks are sometimes an inch or more in diameter, the small bud wood generally used in the United States not being considered desirable by Bahia propagators.

Budding is always done when there is an abundance of sap in both stock and scion and the bark slips readily. If either is found to be dry and the bark does not slip readily, the operation is postponed until a more favorable time.

The incision in the stock is made in the form of an inverted T. The bud, after insertion, is tied firmly in place with a portion of a leaflet of the nicurí palm (*Cocos coronata* Mart.), made soft and pliable by scalding. This palm is common in all the orange-growing districts of Bahia. Fifteen days after insertion the wrap is removed, and at the end of another 15 days, if the bud has started into growth, the stock is cut off about 2 inches above it.

At the end of six months to a year, if grown in the nursery, the young trees are ready for transplanting. The tender growth is removed and the plant dug with a ball of soil around the roots. If they are to be kept any length of time before planting in permanent locations or are to be offered for sale in the markets, as is often the case, the trees are placed in small baskets, about 6 to 8 inches in diameter and 8 to 12 inches in depth, made from splints from the woody leafstalks of the dendé palm (*Elaeis guineensis* Jacq.). These baskets take the place of the clay flower pot and are widely used.

PLANTING AND CULTURAL PRACTICES.

The cost of uncleared lands suitable for orange culture near the city varies from \$10 to \$100 per acre, and farther away, from \$3 to \$15 per acre. The expense of clearing is frequently more than met by converting the natural growth of timber into charcoal, which can always be sold at a remunerative figure. Immediately after clearing, the orange trees may be set and mandioca (*Manihot esculenta* Crantz) planted between the rows, or the ground may be cultivated to mandioca for a year before the oranges are set out. Mandioca matures in one year. The cost of planting, cultivating, and harvesting the crop is about \$20 per acre and its value from \$30 to \$40 per acre, leaving a sufficient profit as a rule to cover the cost of planting and caring for the orange trees during the first few years of growth, after which the cultivation of mandioca in the orchard is discontinued.

It is customary to plant from 80 to 100 trees to the acre, though on rich soils this may be increased to 120. The market price of budded trees varies from 65 cents to \$1 each, according to size. In planting, the crown of the roots is barely covered with soil. In dry seasons it is sometimes necessary to water the young trees by hand for a few weeks, but beyond this little or no irrigation is practiced.

In most groves the only cultivation consists in clearing the land of weeds two or three times a year with a heavy hoe. Labor for this purpose costs 30 to 60 cents a day. Sometimes the work is let out on contract at the rate of \$3.30 per acre for each cleaning. Hoeing is usually done during the dry season, when conditions are most favorable for killing the weeds.

The most healthy, vigorous, and productive orchard observed in Bahia was planted to Angola grass (*Panicum barbinode* Trin.; Pl. IV), which prevents soil erosion and is at the same time an important source of income as a green forage. Manure is frequently applied to stimulate the growth of the grass, the oranges, no doubt, sharing in the benefits of this practice. In most of the small groves little or no manure is applied directly to the trees; in some of the larger ones, however, the practice of applying manure or other fertilizers has become common in recent years. Several groves in which the trees

were formerly starved, unhealthy, and unproductive are said to have been brought back to a state of health and fruitfulness by the use of manure.

Dairying in connection with orange culture is an interesting feature of the Bahia orange industry. The milk is sold in the city at a very profitable price, usually 25 cents a quart at retail and 15 cents at wholesale. The manure is used on the orchards and in every case is said to have had a marked effect in increasing the production and health of the trees.

As a rule, little pruning is practiced. When the trees become old and seriously weakened by the ravages of gum disease they are often renewed by allowing the suckers which start up from the trunk above the union of the stock and scion to form a new top; in fact, it might be called a new tree. The old trunks are either allowed to rot off or are cut away. Having a large and established root system, the suckers make rapid growth and often begin to bear fruit within two or three years.

The orchards usually come into bearing within two or three years after planting. The oldest known trees in Bahia were planted over 40 years ago and are still producing good crops of fruit.

ENEMIES OF THE ORANGE TREE IN BRAZIL.

In the older orchards many of the trees are affected by gum disease, which seriously impairs their health and eventually kills them or results in their having to be renewed by the production of suckers from below the affected region on the trunk.

Chlorosis, or mottle-leaf, exists in many of the orchards, but the growers take no cognizance of its existence as a disease. They consider it a constitutional weakness of the tree due to a lack of proper nourishment.

A parasitic vinelike shrub known as *herva de passarinho*, a species of *Phoradendron*, is frequently found on the trees and has to be removed. If allowed to remain, it will in time smother the tree. Several epiphytic plants of the order *Bromeliaceæ* are also occasionally found on orange trees, but do not, it is believed, cause any appreciable injury and are easily removed. The trunks of the trees, especially in the older orchards, are covered with lichens, algæ, and other low forms of plant life, none of which apparently does any very serious harm.

Scale insects of several species are prevalent, but seem to be held in check by some natural agency and do not as a general thing appear to produce serious results. Practically the only insect which is an actual menace to the industry and against which combative measures are taken is the *saúva* or *saúba ant* (*Atta* sp.).

These ants are black and about half an inch in length. The head in proportion to the body is large. The species is probably closely related to the leaf-cutting ant of Texas and Cuba (*Atta* sp.). While they cut the leaves of practically any plant, they appear to be particularly fond of orange leaves, and it is not infrequent in Brazil to see a good-sized orange tree nearly defoliated in a single night. The leaf-cutting ants are practically agricultural ants. The fragments of the leaves cut from the trees are carried into a chamber in their nests. Here they decay and form the basis for their so-called "mushroom garden." The fungi that are cultivated upon these small bits of decaying leaves supply the food of the entire colony. It is reported, and doubtless is true, that these gardening ants exercise every precaution to prevent their mushroom beds from becoming contaminated by other species of fungi. The Brazilian farmer combats this pest by forcing hot fumes of sulphur into the runways.

In view of the fact that no serious effort is made to combat insect or fungous enemies other than the saúva ant, the comparatively small amount of injury which such enemies appear to do is remarkable.

THE ORANGE CROP OF BAHIA.

While ripe oranges are obtainable in Bahia every month in the year, there are two principal seasons, one in June and July and the other in December and January. The June crop is considerably the larger, and the fruits are considered by Bahians much sweeter and juicier than those which ripen in December.

It is difficult to estimate the average yield per tree. The number counted on numerous trees examined at the beginning of the December season varied from a few dozen to nearly 500, with an average of about 250. In groves which had been manured and were generally well cared for, the trees usually carried from 300 to 400 fruits, and this, it must be remembered, does not include the fruit produced in the June crop. Where the trees received good care the yield will probably compare very favorably with that in California. (Pl. V.)

While pruning shears are occasionally used in picking, the fruit is usually pulled from the tree and either allowed to fall to the ground or dropped into a sack. Sometimes the peddlers who come from the city to buy the fruit lead their horses or mules into the grove and toss the fruits from the tree into the large baskets, called "cassuás," strapped on each side of the animals' backs. Frequently the fruits are graded into two sizes before being carried into the city for sale.

Careless picking and handling naturally result in many injuries, such as gravel bruises, abrasions, and punctures of the skin. These must, of necessity, encourage the growth of blue mold and other fungi, but the effect is not so serious as it would be if there were a

large export trade and the fruit were held in storage for some time. At present it is picked from day to day to supply the market demands, and very few days elapse before it is consumed.

Oranges are either sold on the tree to peddlers who pick them, carry them to town, and hawk them about the streets, or picked by the orchardist and delivered to the buyer at the grove. Practically all of the crop is carried from the groves to the city, usually a distance of 2 to 4 miles, in baskets, either by horses and mules or on the heads of the natives. The grower usually receives \$1.50 to \$2 per hundred oranges, and the buyer retails them at about \$3.30 a hundred. The local demand is said to be increasing rapidly, and orange culture is proving to be one of the most remunerative agricultural industries. At the present time the best groves are said to be returning net annual profits of \$75 to \$150 per acre.

An experimental shipment, consisting of a box of 96 fruits, carefully picked and handled so as to avoid bruising, was made from Bahia to Washington, D. C., on January 4, 1914. When examined in Washington on January 27, with the exception of one partly decayed fruit the shipment was in perfect condition. With careful handling and proper facilities for shipping there is little doubt that the Bahia orange can be successfully carried to the leading orange markets of the world. The light greenish yellow color will perhaps make it a slow seller at first, until buyers have learned that it is characteristic of this variety as grown in Bahia.

THE FRUIT OF THE NAVEL ORANGE AT BAHIA.

The navel orange of Bahia has long been known to travelers on the eastern coast of South America, many recent travelers having asserted that it is a fruit vastly superior to the California navel orange. Some declared that its superiority is due to the climate; others affirmed that better types are grown in Bahia than in California, or that since its introduction into North America the navel orange has degenerated.

True it is that there are marked differences in the size, the color, and the quality of the navel oranges produced in these two widely distant regions, though of the same horticultural variety. As to the superiority of one over the other this is a question which can only be decided by individual taste. The navel orange of Bahia (Pl. VI) is large, varying from $3\frac{1}{2}$ to over 4 inches in diameter; yellow green in color, unless very ripe; extremely juicy and sweet, lacking that sprightly subacid flavor which characterizes the California product. The skin is comparatively thin, and, although the flesh is filled with juice, it is not quite so tender as in the California fruit. Those who prefer a sweet fruit would probably choose the Bahia orange

as the better; others who relish a slight degree of acidity would give the California product first place.

Analyses made by H. C. Gore, Chemist in Charge of the Fruit and Vegetable Utilization Laboratory, Bureau of Chemistry, United States Department of Agriculture, show the principal differences in chemical composition of 42 navel oranges from Bahia, Brazil, and 13 from Riverside, Cal. Those from Brazil were picked on January 2, 1914, at which time they should have been fully ripe, since they were fruits of the December crop. Those from Riverside, Cal., were picked about the end of March, 1910, and were also fully ripe. The comparison should therefore be a fair one. (Table II).

TABLE II.—*Comparative analyses of navel oranges grown at Riverside, Cal., and at Bahia, Brazil.*

Source of fruit.	Average weight.	Percentage of—		Analysis of juice.							
		Peel.	Rag in pulp.	Specific gravity.	Acid (as citric).	Solids.	Ash.	Alkalinity of soluble ash (K_2CO_3).	As invert.		Su- crose.
									Red- ucing.	Sugar.	
Bahia, Brazil: Average of 42 fruits.	Grams. 366	20.4	1.5	1.0376	0.466	9.4	0.353	0.24	3.43	7.48	3.85
California: Hermosa ranch— Average of 5 fruits from sandy soil.	199	29.1	1.69	1.0633	1.09	15.47	.51	.23	6.44	12.40	5.66
Average of 4 fruits from adobe soil.	193	31.2	2.04	1.0638	1.09	15.57	.49	.22	6.08	12.72	6.31
Eureka ranch— Average of 4 fruits.	{ 235 210.5	{ 34.0 31.2	{ 1.89 1.97	{ 1.0572 1.0585	{ 1.08 1.01	{ 14.06 14.36	{ .55 .49	{ .18 .18	{ 5.60 5.41	{ 10.93 11.29	{ 5.07 5.58

It will be seen from Table II that the percentage of peel or rind is considerably lower in Bahian fruits than in those grown in California. The percentage of "rag," by which term is designated the fibrous matter which remained after all soluble substances were washed out of the pulp, is slightly lower in Bahia than in California.

The most noteworthy features of the chemical analysis of the juice are the low percentage of citric acid and the low percentage of sugar in the Bahian product as compared with that of California.

Table II brings out the difference between humid-climate fruits grown in an equable temperature and those of an arid climate with decided drops in temperature. The dry climate and continuous sunshine of California give the sugar, while the decided drop in winter temperature tends to develop the organic acids and also color.

Decided variation, thought to be bud variation, was observed in every orchard, not only in the fruits but in the vegetative characters of the tree as well. All of the various types originating through bud variation which have been observed and defined in the California

orchards, and in addition several new ones, were found to be present in Bahia. The type known in California as the "Australian Navel" orange, characterized by a somewhat corrugated appearance and flattened shape, was observed in several groves. In some cases the production of these fruits was limited to certain limbs on a tree or even to certain fruit spurs; in other cases there were entire trees of this type. "Australian Navel" oranges are inferior in quality, and the great vegetative vigor of the tree is correlated with a poor yield of fruit. Another type was found in which the fruits have a small and almost rudimentary navel. Opposed to this were forms with the navels extremely large and in several instances protruding.

These and other types were studied with the object of determining, if possible, whether there existed in Bahia any navel oranges superior to those already known in California and therefore worthy of introduction into the United States. Bud wood of a number of the most promising of these forms was secured and they are being tested in California and Florida. Because of the important effect of climate on the size and character of the fruit, it is impossible to determine in advance whether types which appear valuable in Bahia will retain their characteristics in the United States. This can only be decided by a trial.

CITRUS FRUITS OF BAHIA OTHER THAN THE NAVEL ORANGE.

In addition to the navel orange there are several other citrus fruits which are cultivated to a limited extent in Bahia. One of the most important of these is the tangerine, grown commercially in a small way, the trees usually being scattered among the orange trees in the orchards. (Pl. I.) The bitter or sour orange (*Citrus aurantium* L.), which already has been mentioned in connection with propagation, is usually represented by one or two trees in each grove, which provide seed for nursery purposes. Sweet and sour lemons and the common lime are occasionally seen, the lime usually being present in the markets in small quantities.

Good grapefruits are unknown in Bahia. A few fruits seen in a garden near the city, which appeared to be inferior forms of the shaddock (*Citrus grandis* (L.) Osbeck), were seedy and thick skinned, and no use was made of them. The so-called "lime orange," laranja lima (*Citrus* sp.), which appears to be more common in Rio de Janeiro, was seen in an orchard at Agua Comprida, about 20 miles from Bahia. It is the size of an ordinary orange, very juicy, and combines the taste of the orange and the lime. The citron (*C. medica* L.) and one or two other citrus fruits are occasionally grown, more as curiosities than anything else.

CITRUS FRUITS OF THE REGION AROUND RIO DE JANEIRO.

There are a number of districts in the vicinity of Rio de Janeiro where citrus fruits, especially oranges, are grown commercially to supply the markets of the city. The most important are Maxambomba, Nictheroy, and the Banca Velha and Porta d'Agua districts near Cascadura.

Maxambomba, 20 miles from the city on the Central Railway, is the largest and by far the most prosperous of these districts. It is difficult to estimate the approximate acreage in oranges, but there are half a dozen groves varying from 5 to 10 acres in extent in the immediate vicinity of the village and others scattered upon the near-by hills (Pl. VII). Most of the groves are better cared for than those seen in the other districts noted above and present a much healthier and more vigorous appearance.

At Nictheroy most of the orange groves are located in the suburb known as Sao Gonçalo, about 4 miles from the center of the city, but easily accessible by means of the electric cars. Here there are numerous small plantations of 1 or 2 acres in extent and a few larger ones. As in the other districts, practically all the groves are located on the hillsides or on sloping ground.

Banca Velha and Porta d'Agua, in a beautiful valley about 12 miles west of Rio de Janeiro, contain numerous small groves and a few several acres in extent. As at Nictheroy, not as much attention is given to the culture of the orchards as at Maxambomba, and the groves do not, as a rule, have a thrifty appearance.

In all these districts the soil appears to be fertile and well suited to orange culture. In the valleys the sandy loam on the surface is sometimes underlain with a subsoil of reddish clay, while on the hillsides the loam is frequently badly washed by the rains. At Maxambomba the reddish clay is visible, the hillsides being of light clay loam.

The methods used in propagating and cultivating the trees and in picking and handling the fruit differ in no important respects from those practiced at Bahia. Laranja da terra (*Citrus aurantium*), the bitter or sour orange, is generally used as a stock on which to bud and by most growers is considered the best. The orchards are rarely cultivated, but the surface is cleaned of weeds from time to time with a hoe. The trees, which are often stunted in appearance, are planted closer together than at Bahia, 12 by 12 feet being a common distance.

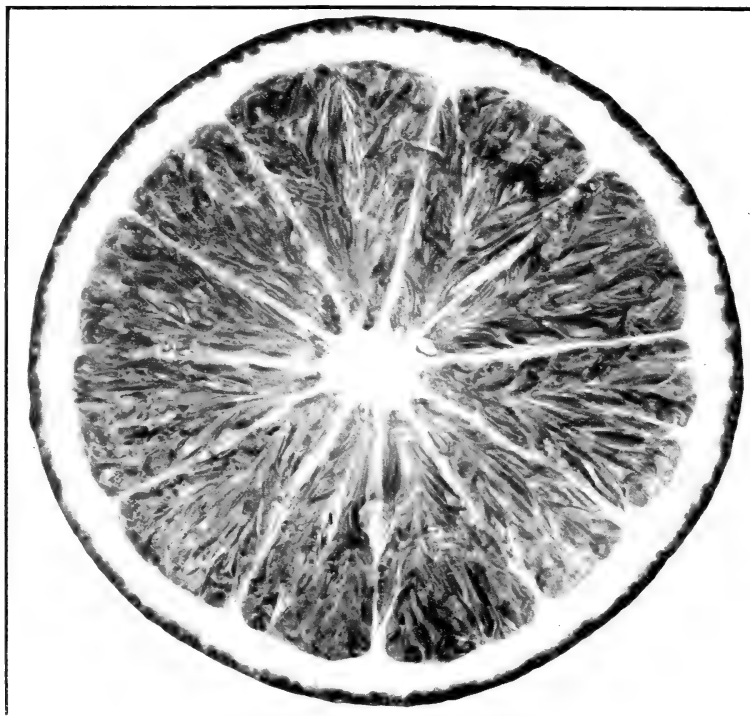
Of the numerous varieties of the orange known at Rio de Janeiro, only three are cultivated extensively, Selecta, Pera, and Natal, the latter being very similar to Pera if not actually synonymous with it. Many horticulturists at Rio de Janeiro consider Selecta the best



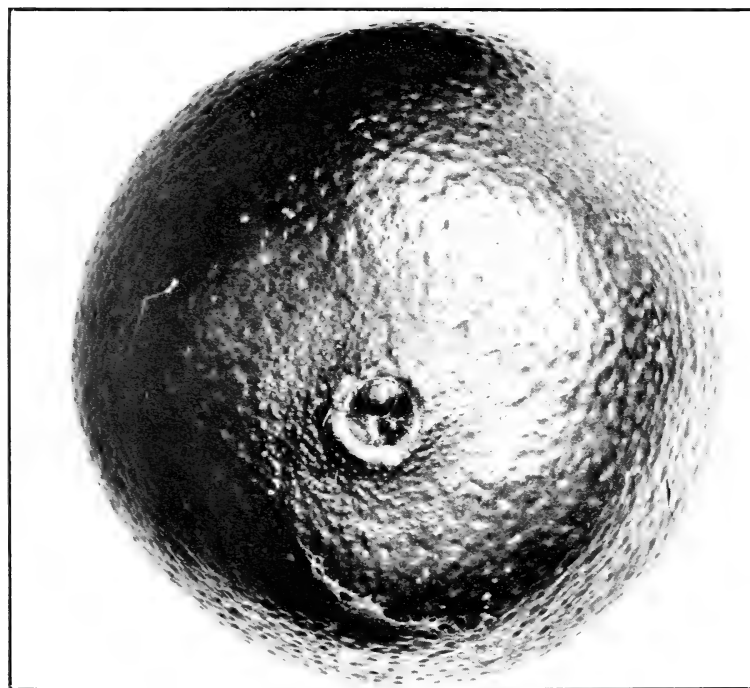
NAVEL ORANGES ON THE TREE.

P15369FS

When well cared for, the trees in Bahia orchards are about as productive as in California, and in place of one crop a year there are two, one ripening from December to February and the other during June and July. The second crop, however, is usually not heavy. The variation in size and character of the navels, even among fruits on the same tree, is clearly shown in this illustration. Photographed in the grove of Col. F. da Costa, Matatu, Bahia, Brazil, December 6, 1913.



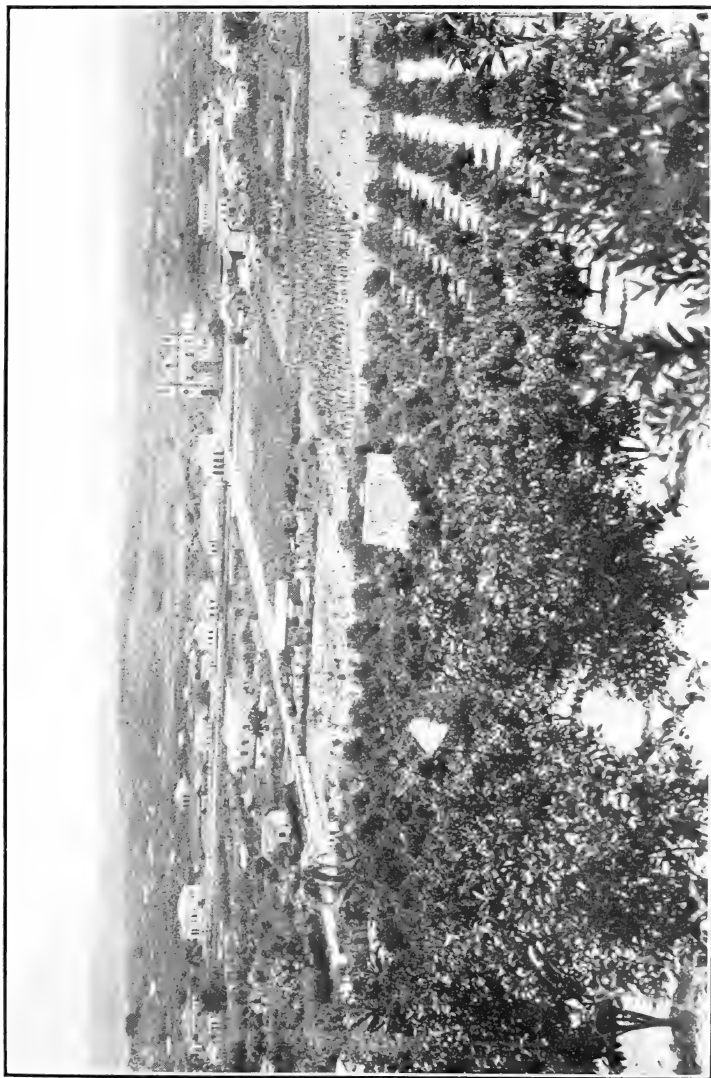
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A TYPICAL NAVEL ORANGE AS GROWN AT BAHIA AND A SECTIONED FRUIT OF THE SAME VARIETY.

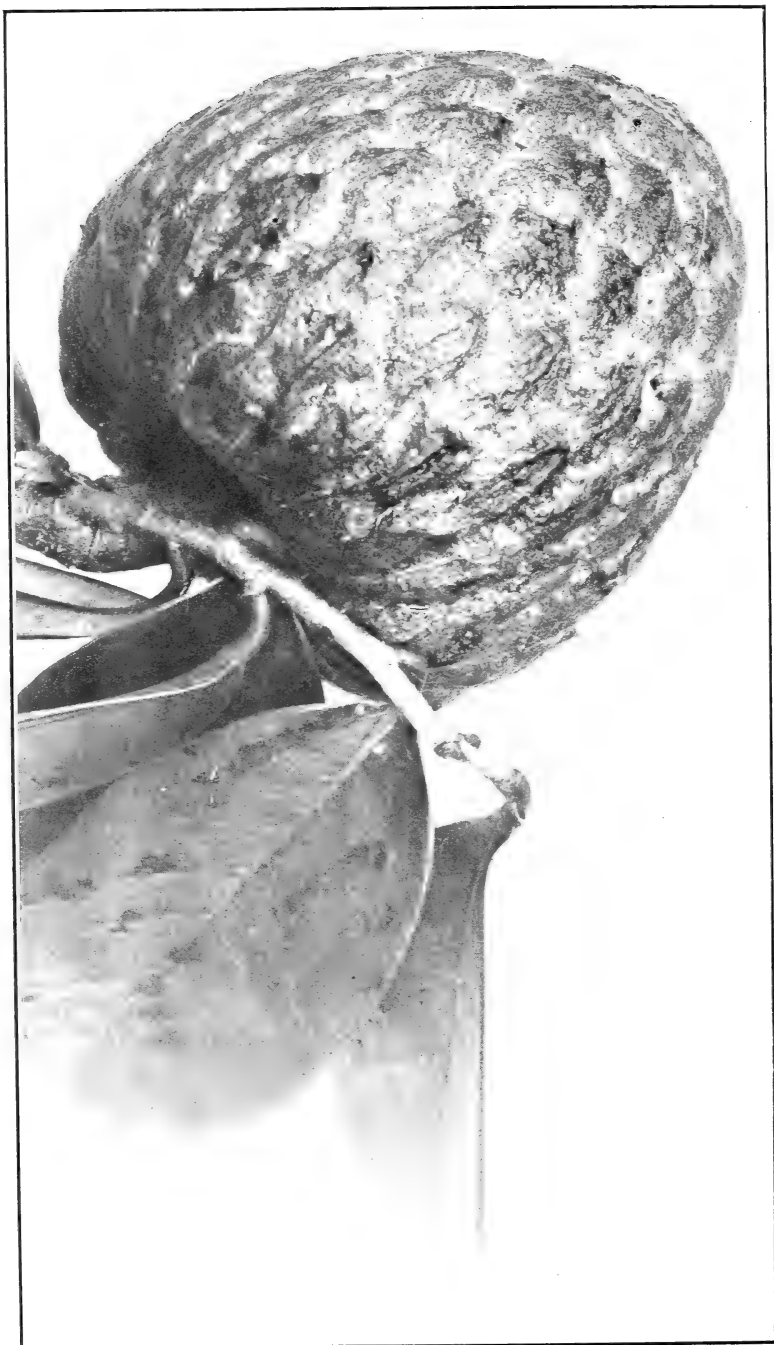
Fruits considerably larger than this are common in orchards at Bahia, Brazil, but this may be taken as an average specimen. The Bahia navel oranges are sweeter and more juicy than the Washington Navels grown in California, but the flesh is coarser in texture, and the flavor is not so sprightly. The skin is thinner and rarely becomes as brightly colored as it does in the drier climate of California. Photographed November 27 and 28, 1913. (Natural size.)



P1607FS

AN ORANGE ORCHARD AT MAXAMBOMBA, NEAR RIO DE JANEIRO, BRAZIL.

A large part of the oranges sold in Rio de Janeiro are grown in the vicinity of Maxambomba, about 20 miles inland. The soil here is a clay loam, apparently well adapted to citrus culture. The 4-year-old orchard shown in the illustration is planted to the Pera variety, which is the principal one grown in this region. The soil is not cultivated, but is occasionally hoed to keep down the weeds. Photographed March 19, 1914.



P15526F5

A NEW FRUIT, A RELATIVE OF THE CHERIMOYA.

This araticum (*Annona salzmannii*) is found in the suburbs of Bahia. The fruit was previously unknown to science, although specimens of foliage and flowers, from which the species was named, were collected and taken to Europe years ago. The flesh is milky white, sweet, and slightly aromatic. The numerous black seeds are about the size of a common bean. Photographed at Bahia, Brazil, March 12, 1914. (Natural size.)

orange in Brazil. Though not seedless, like the navel orange, its flavor is considered better and the flesh more delicate in texture.

The slightly oblate form of this fruit has given rise to the name *laranja deprimida*, or "flattened orange," which is sometimes applied to it. In size it is large, though somewhat smaller than the average navel orange of Bahia, measuring $3\frac{1}{2}$ to 4 inches in diameter. The skin is thick, yellowish green in color early in the season, later becoming bright golden yellow. The flesh is tender and very juicy, with tender rag but a rather large, open core. The seeds are rather large, commonly 10 to 20 in number.

In flavor *Selecta* is strikingly suggestive of the California navel orange; there is more acidity than is normally found in the navel orange produced at Bahia and consequently a more sprightly flavor.

The tree is not as prolific as the other commercial varieties grown at Rio de Janeiro. The fruit commences to ripen early in March and continues until October, the main season being June and July. The relationship between *Selecta* and the navel orange has already been discussed.

Pera is considered second only to *Selecta*. It is a smaller and sweeter fruit, coming at the opposite season of the year and thus not competing with *Selecta* in the market. A good specimen is 3 inches in diameter, slightly elongated in form, but not pyriform as the name *laranja da pera*, "pear orange," seems to indicate. The skin is smooth and fine in texture, deep golden orange in color, not more than an eighth of an inch in thickness. It adheres closely to the light yellow flesh. The rag, though not thick, is objectionably tough. The juice is abundant and of very sweet flavor, perhaps a trifle lacking in acidity.

In the groves of Maxambomba (Pl. VII) this variety is grown practically to the exclusion of all others. At Nictheroy *Selecta* is the most prominent, though Natal, "the Christmas orange," which in reality appears to be *Pera* under another name, is cultivated to a certain extent.

Most of the other citrus fruits found at Bahia are grown also at Rio de Janeiro, the tangerine being especially popular in the Nictheroy district.

MISCELLANEOUS FRUITS GROWN AT BAHIA.

With its rich soil, mild climate, and abundant rainfall Bahia is preeminently suited to fruit culture. That the Brazilians have not been neglectful of this fact is evidenced by the large number of species cultivated, some of them indigenous to the region and others introduced from the Orient by the Portuguese in the early days of

colonization. Fruit forms an important item in the diet of the people, and the abundance and variety offered in the markets are a constant surprise to visitors.

With the exception of the orange and the pineapple, of which there are extensive commercial plantations, nearly all fruit trees are grown near the houses and in the gardens of the natives, either as single specimens or in small numbers, frequently crowded together without regard to order. Under such conditions the trees receive very little attention; yet their growth is usually vigorous and their appearance indicative of health.

The Indian tamarind (*Tamarindus indica* L.) is common, the fruit being used principally for making a cooling drink. The carambola (*Averrhoa carambola* L.), another Indian fruit, is also cultivated, but it is not very common. *Phyllanthus acida* (L.) Skeels, known as groselha ("gooseberry"), is seen in many gardens. The avocado, locally called abacate (*Persea americana* Mill.), is one of the most popular of fruits during its season and is cultivated on a commercial scale, one grove alone containing nearly 800 trees. Budding or grafting is not practiced. Among the seedlings none was seen which appeared to be superior to those grown in Florida and the West Indies. The caja and the caja manga (*Spondias lutea* L. and *S. cytherea* Sonnerat) are seen occasionally at Bahia; both are used for making sherbets as well as eaten in the fresh state. The sapodilla, locally known as sapotí (*Achras zapota* L.), grows to large size and its fruit is highly esteemed. Two varieties are distinguished by the natives, one oval or elliptical and the other round. One or more species of Passiflora, known as maracujás, are occasionally seen, as is the jambo, or rose-apple (*Caryophyllus jambos* (L.) Stokes).

The papaya (*Carica papaya* L.), known in Portuguese as mamão, is esteemed as a breakfast fruit. Two forms are distinguished, a small, usually round or oblate type, known simply as mamão, and a large, elongated form known as mamão da India. The latter is considered much the better in quality and always brings a good price in the market. When the fruits are picked it is customary to make four or five shallow incisions through the skin from base to apex and then allow 24 hours or more for the milky juice to exude before the fruit is eaten. This tropical custom is said to improve the flavor of the flesh. Propagation is usually by seed, though in rare instances the mamão da India is said to be grown from cuttings in order to insure its coming true to type.

The common guava of the Tropics (*Psidium guajava* L.), used principally for jelly making, is present in many of the gardens. The manufacture of jelly is carried on commercially, but not on so large a scale as in the State of Pernambuco, farther north. Several in-

digenous species of *Psidium*, known as Araça do Rio, Araça cagão, etc., are also grown to a limited extent.

The pineapples of Bahia (called abacaxi in Portuguese) are justly renowned; one author describes them as "mellow and overrunning with juice of incomparable flavor." By the Brazilians they are considered inferior only to those of Pernambuco. During the height of the season they are brought in boatloads across the bay from the mainland and heaped up in large piles at the waterside or in the markets.

The jak of the Malaysians (*Artocarpus integra* (Thunb.) L. f.), here known as jaca (jack fruit), which, like the mango, was introduced by the Portuguese in the early days, is not only eaten and appreciated by the lower classes but when abundant is utilized as stock food. Cattle appear to be especially fond of it. The dried pulp, candied, wrapped in tinfoil, and packed in boxes holding about a pound, has recently been put on the market. The fruta de pão, or breadfruit (*Artocarpus communis* L.), is not as common as the jaca, or jack fruit, but is grown in many gardens.

Of annonaceous fruits there are several, of which the most important is the fruta de conde (*Annona squamosa* L.), so named, it is said, because of its having been introduced about the end of the seventeenth century by the Conde (Count) de Miranda. The fruits grown here are of large size and excellent quality. A rare species, *Annona salzmanni* A. DC., usually known under the name of araticum, was seen in several gardens near Cabulla and Retiro. The fruits are about the size of those of the custard-apple (*A. reticulata* L.), with white, rather insipid flesh (Pl. VIII). They are occasionally sold in the market.

A number of other important fruits are grown or occur wild in the region about Bahia. These are described somewhat in detail, since they deserve to be called more particularly to the attention of American horticulturists.

THE GRUMIXAMA.

Among the cultivated myrtaceous fruits the grumixama or grumichama (*Eugenia dombeyi* (Spreng.) Skeels; *Eugenia brasiliensis* Lam.) is one of the most interesting. It is sometimes called the "cherry of Brazil," a term which not inaptly describes its appearance and taste. The tree, 20 to 25 feet in height, is shapely and attractive in appearance, with ovate-elliptical, glossy, deep-green leaves 2 to 3 inches in length. The small white flowers are followed by pendent fruits, round or slightly flattened, about three-fourths of an inch in diameter, glossy, deep crimson in color, crowned at the apex by the persistent green sepals. The thin, delicate skin incloses a soft, melting pulp of mild and agreeable flavor, strikingly suggestive of a

Bigarreau cherry. The seeds are rounded or hemispherical when only one or two are present; sometimes there are three or more, in which case the size is reduced and they become angular.

The rapidity with which the fruits develop is surprising; within a month from the time of flowering they have reached maturity and are falling to the ground. Tavares¹ states that the trees, even of the same variety, do not all ripen their fruit at the same time, some blooming much later than others and thus extending the season from November to February. Three varieties are distinguished, the difference being in the color of the pulp; in one it is dark red, in another vermilion, and in the third white. All three are said to be of equally good quality.

The grumixama is much more common in southern Brazil, particularly in the States of Parana and Santa Catharina, than it is at Bahia. Little attention is paid to its culture, but it is said to prefer a deep and fertile soil. Its propagation is entirely by seed, the trees coming into bearing at 4 or 5 years of age.

The fruit is usually eaten while fresh, but is well adapted to the preparation of various sorts of jams and preserves, in the manufacture of which the Brazilians are unusually adept.

THE PITOMBA.

Another myrtaceous fruit occasionally seen in the gardens of Bahia is the pitomba (*Eugenia luschnathiana* Berg), stated to be indigenous to this region. It is not common in cultivation.

Like the nearly related grumixama, the tree is particularly handsome and worthy of planting for ornamental purposes alone. It attains a height of 20 to 30 feet, with compact, dense foliage, the individual leaves being lanceolate, about 3 inches in length, glossy and deep green above, lighter green on the under surface.

The fruits (Pl. IX), which are borne upon a slender stem about 1 inch in length, are broadly obovate in form, an inch in length, with the apex crowned by four or five green sepals half an inch long. The color is bright orange-yellow. Inclosed by the thin, tender skin is the soft, melting, bright orange-colored flesh, very juicy, aromatic, and of an acid flavor. The seeds, normally one in number, but sometimes two, three, or even four, are rounded or angular and attached to one side of the seed cavity.

The season in Bahia is November and December. The tree as a rule is not so productive as the grumixama or some other myrtaceous fruits, but nevertheless bears a fair crop of fruit.

Propagation is readily effected by means of seed, which appears to be the only method used. Volunteer seedlings spring up abundantly

¹ Tavares, J. S. As fruteiras do Brazil. In Broteria, Ser. Vulgar. Sci., v. 10, fasc. 6, p. 420. 1912.

under the trees when fruits remain on the ground. Like nearly all the other myrtaceous fruits observed in Brazil the pitomba seems capable of rapid improvement in the hands of the plant breeder.

THE GENIPAPO.

The genipap of the British West Indies (*Genipa americana* L.), known in Brazil under the name of genipapo, is a close relative of the Gardenia. It is common in Bahia, huge baskets of the fruit being offered in the markets during the months of February and March. While its flavor is rather peculiar and not certain to please a European at first trial, the fruit appears to be quite highly esteemed by the Brazilians and is used by them in various ways.

The tree attains a height of fully 60 feet. It is symmetrical and stately in appearance, but devoid of foliage for a part of the year, as the species is semideciduous. In November it is covered with small yellow flowers. The leaves are a foot or more in length, oblong-ovate, dark green in color, sometimes entire, sometimes more or less dentate. The fruit is the size of an orange, broadly oval to nearly round in form, russet brown in color. After being picked from the tree it is not ready to be eaten until it has softened and is bordering on decay. Immediately under the thin, delicate skin lies a layer of granular flesh a quarter of an inch or more in thickness; within this are the numerous seeds surrounded by yellowish brown pulp. The seeds are compressed, about a quarter of an inch in diameter, and so abundant that it is difficult to eat the pulp without swallowing them. The flavor is characteristic and quite pronounced; it may be likened, perhaps, to that of dried apples, but is stronger, and the aroma is considerably more penetrating.

A liquor which is made from the genipapo retains the distinctive flavor and aroma of the fruit to a marked degree. Its manufacture is carried on commercially in a small way.

A refreshing drink is prepared from the ripe fruit, with the addition of sugar and water. The green fruit yields a dye, which, according to Barbosa Rodrigues, is employed by the Mundurucú Indians for tattooing, and also for coloring clothes, straw, and hammocks.

THE GRAVATÁ.

An oblong straw-colored fruit, known to the natives as gravatá, is occasionally seen in the markets of Bahia. It is a species of Bromelia. It is not cultivated, but occurs wild in this region and is gathered and brought to market by the natives. Its close relationship to the pineapple makes it of peculiar interest. Unlike the pineapple, in which the individual fruits are fused together and form a single whole, the fruits of the gravatá remain separate. They vary in length from 3 to 4 inches, in thickness from an inch to 1½ inches.

They are usually more or less compressed from being crowded together on the stem; a tuft of dry, brown sepals protrudes about an inch beyond the apex. The flesh is crisp, juicy, white, and contains two or three rows of small flattened seeds. The flavor is spicy and delightfully subacid. Care must be taken to remove the skin before eating, however, as it contains a principle which burns the lips and mouth severely. Like the uncultivated types of pineapple, and to a less extent the cultivated ones, it probably contains raphides and also the enzym known as bromelin.

The name gravatá is not limited to this fruit alone, but in Brazil is commonly applied to a large number of bromeliaceous plants.

THE ABÍU.

The abieiro (*Pouteria caimito* (R. and P.) Radlk.), a small tree of the family Sapotaceæ, produces the fruit known as abíu (the suffix "eiro" being added to names of fruits in Portuguese to designate the tree). It is not common in Bahia, but the fruit is seen in the markets in small quantities during February and March.

The tree is pyramidal in form, reaching a height of 15 to 20 feet. The fruit (Pl. X) is egg shaped, 3 inches in length, and externally orange yellow in color. The skin is thick and tough. Surrounding the two or three large oblong seeds is the translucent, white flesh, of delicate flavor, resembling that of the sapodilla (*Achras zapota* L.). Unless fully ripe it contains a milky fluid which coagulates on exposure to the air and sticks to the lips in an annoying manner.

The abíu appears to be used only as a fresh fruit. It is, perhaps, more popular at Rio de Janeiro than at Bahia, though its cultivation is not extensive at either place. At Para it is said to be one of the commonest fruits.

THE PITANGA.

The pitanga (*Eugenia uniflora* L.), known in southern Florida as Surinam cherry, is widely grown in Bahia as a hedge plant. It seems admirably adapted to this use, forming a compact, bright-green hedge, thickly foliated from the ground up. It produces small, oblate, ribbed fruits, deep crimson in color and about an inch in diameter; when grown as a hedge, however, the plants do not bear as heavily as when given more room and allowed to develop unhindered. The small, ovate, glossy green leaves are frequently scattered over the floors of the houses, yielding, when bruised by trampling, an agreeable spicy odor, which is much liked and thought to be efficacious in driving away flies.

THE CASHEW, OR CAJÚ.

One of the most abundant and popular fruits is the cashew, or cajú (*Anacardium occidentale* L.), of which there are innumerable

wild trees in the immediate vicinity of the city. The tree is practically never planted, and so far as could be learned no effort is being made to select and propagate the better types. Quantities of the fruits are gathered from wild seedling trees and brought into the market, where their aromatic fragrance soon dominates all other odors. The island of Itaparica, in the bay of Todos os Santos, about 7 miles from the city, is said to produce the finest cashews. One tree on the island, the "Manteiga" or "butter" cashew, is especially famed. Aside from being eaten fresh, in which state great quantities are consumed by the natives, the cashew makes excellent jams and jellies and a light wine, all of which are manufactured commercially.

THE MANGO.

The mango (*Mangifera indica* L.), introduced from India in the early days, vies in popularity with the cashew, though it is not produced in such lavish profusion. Large seedling trees are seen everywhere, not only in gardens, but along the roadsides wherever seeds have chanced to fall. The immense size which the tree attains in the deep soil of this region is astonishing; a magnificent specimen at Cabulla (Pl. XI), said to be over 100 years old, was found to have a spread of 120 feet, while the trunk was over 25 feet in circumference.

Itaparica is famed throughout Brazil for its mangos. Most of the trees on the island are seedlings, of which more than 180 are known by name. Quantities of fruit are exported to Rio de Janeiro, the growers receiving \$5 to \$10 per hundred. At this rate, some of the largest trees are reported to yield an annual income of \$200.

It must be admitted that most of the mangos grown in Bahia and elsewhere in Brazil, grafted varieties as well as seedlings, are somewhat inferior to the best of those cultivated in India, the Philippines, or the United States. There is one variety, however, whose unusual beauty and exceptional commercial qualities make it of particular interest. This is the Manga da rosa (rose mango), grown commercially in the vicinity of Pernambuco and to a less extent at Bahia, Rio de Janeiro, and other points in Brazil. During the holiday season quantities of the fruit are shipped to Rio de Janeiro, principally from Pernambuco, and sold by dealers in fancy fruits at the equivalent of 65 to 80 cents each. The attractiveness of this mango, with its cordate, regular form, slightly beaked at the apex, and its contrasting shades of apricot and scarlet, can scarcely be resisted. It will average about 1 pound in weight. The fiber is coarse and rather long; the quality is fair; the flavor and aroma are very good, indeed. However, the variety as a whole can not be considered the equal of the Mulgoba, Paheri, or several other Indian

mangos grown in the United States. Its unusual attractiveness and the fact that it withstands shipment and handling much better than other varieties observed make it of interest and well worthy of introduction for experimental tests in North America.

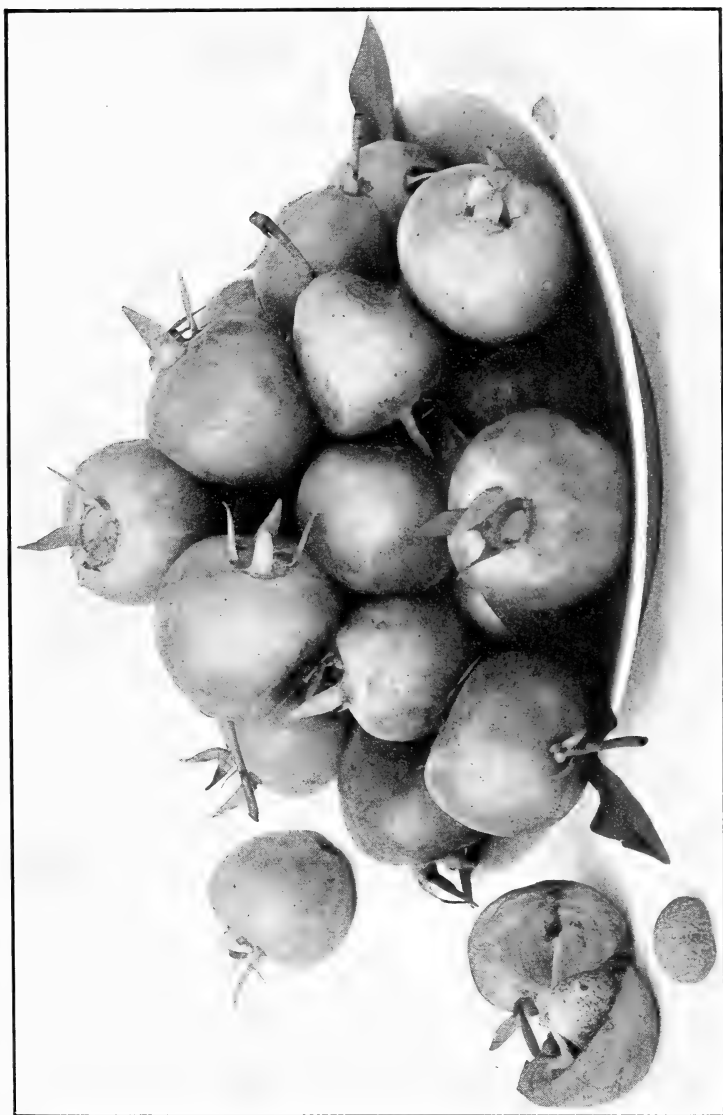
Manga da rosa is believed to have been introduced into Brazil from Mauritius. Two subvarieties are known in Bahia, "da terra" and "do Rio," differing slightly in the shape of the fruits. Inarched trees are produced in small quantities and sell at \$3 each. The variety is polyembryonic, like the "No. 11" mango of Florida and the West Indies, and appears to be a regular and prolific bearer.

There are four other named varieties of the mango which are propagated by grafting and are more or less well known at Bahia as well as in other sections of Brazil. The best of these is probably the Itamaraca, which takes its name from the island of Itamaraca, off the Brazilian coast near Pernambuco, a place especially noted for its mangos. The fruit is small and of very unusual form, distinctly oblate, with a small protuberance, or "nak," at the stigmatic point near the apex. Usually it does not average more than 3 inches in diameter. Its color is orange yellow, and the flesh is free from fiber, is aromatic, and of piquant, spicy flavor. It is generally considered the best flavored of the grafted varieties. Espada (sword), another named variety, is apparently a seedling type, of which individuals are sometimes propagated by inarching. Its form is distinctive, long and curved at each end. It is usually yellowish green when ripe, not at all attractive in appearance. While its flavor is fair, the flesh is very fibrous and it must be ranked as inferior. Carlota and Augusta and two other named varieties, neither of them being widely grown. Both are rather small, of good flavor, but with no particular merit.

THE DENDÉ PALM.

The Guinea oil palm (*Elaeis guineensis* Jacq.), known in Bahia as dendé, was doubtless introduced from Africa in the early days of the slave trade. It is frequently seen growing upon the hillsides on the edge of the city and is common around the huts of the negroes. Its tall, straight stem, ascending to a height of 40 or 45 feet, is crowned by a rather compact head of stiff, pinnate leaves about 20 feet in length. While not graceful in appearance, it is handsome and of considerable ornamental value, the scattered groups, which are abundant in the suburbs, being among the most pleasing features of the landscape.

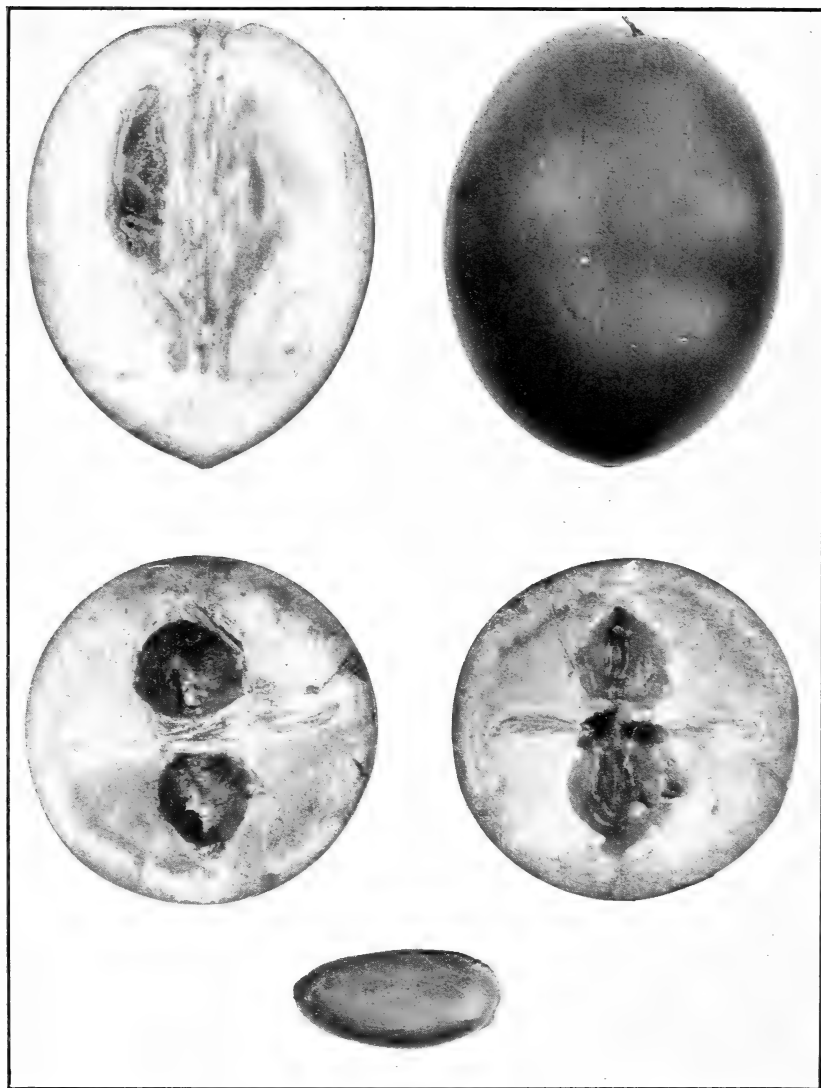
The fruits are produced in crowded bunches, clustered around the trunk at the bases of the leaves. Individually they are oblong elliptical, about 2 inches in length and 1 inch in thickness, dull orange-scarlet in color when fully ripe. The large seed is surrounded by a layer of firm golden yellow pulp, very rich in oil.



P15400FS

THE PITOMBA, AN INTERESTING RELATIVE OF THE GUAVA.

The pitomba (*Eugenia luschnathiana*) is found in the vicinity of Bahia, Brazil. The fruit is golden yellow in color, sharply acid, with a pleasant flavor and spicy, aromatic fragrance. It is sometimes eaten fresh, but more frequently made into preserves and jelly. Photographed at Bahia, Brazil, December 21, 1913. (Three-fourths natural size.)



P14973FS

THE ABIU, A FRUIT RESEMBLING THE SAPODILLA.

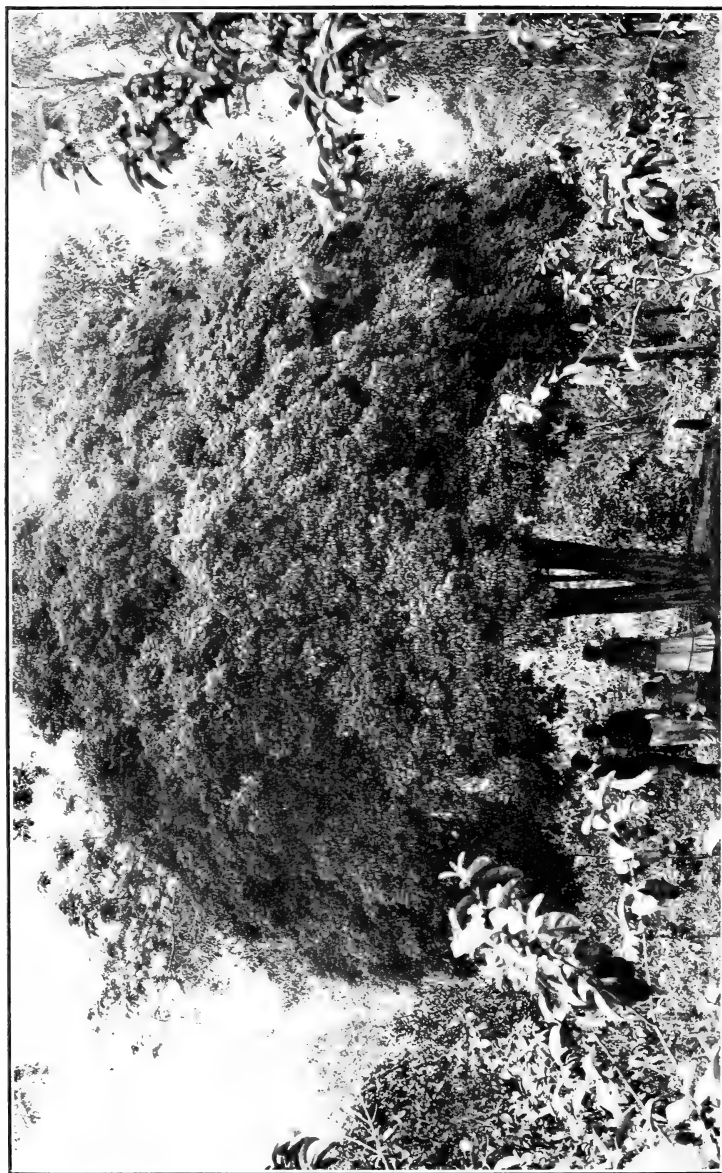
This tree is comparatively rare in tropical America, but it is cultivated at Bahia, Rio de Janeiro, and other places in Brazil. The fruit is bright yellow in color, with white flesh of a sweet, rich flavor, strongly suggesting that of the sapodilla (*Achras zapota*), to which it is related. The tree is small and of very attractive appearance. Botanically it is known as *Pouteria caimito*. Photographed at Bahia, Brazil, November 3, 1913. (Natural size.)



P15374FS

AN UNUSUALLY LARGE MANGO TREE AT CABULLA, BAHIA.

On the deep, fertile soil of this region the mango attains immense proportions. The specimen shown in this photograph is believed to be over a hundred years old. It is 25 feet in circumference and at noonday casts a shadow 120 feet in diameter. This large seedling mango occasionally bears a good crop of fruit of fair quality. Photographed at Col. Lago's, Cabulla, Bahia, Brazil, December 12, 1913.



PHILIPS

THE JABOTICABA TREE (*MYRCIARIA CAULIFLORA*).

A good specimen of this remarkably interesting tree is shown in this illustration. Its compact symmetrical head of small bright-green leaves makes it very attractive. The jaboticaba grows wild in southeastern Brazil and is also cultivated to a greater extent than almost any other native fruit. Photographed at Sr. A. G. Fontes's, Faria d'Água, Rio de Janeiro, Brazil, October 28, 1913.

Dendé oil is an important food product, entering into the preparation of a number of dishes, some of which, such as vatapá, are considered peculiar to the region. While utilized by all classes of people, its greatest popularity is among the negroes, long familiarity having made dendé oil almost as indispensable to them as olive oil is to the Spaniard. The price at which it is sold, 25 to 30 cents for a quart bottle, is not high by Brazilian standards. Its flavor is characteristic, but not objectionably strong. The oil is prepared by a simple process, requiring no special utensils and involving but little labor. The pulp is macerated and placed in cold water, and as the oil rises to the surface it is skimmed off, placed in a pan, and boiled down to remove all water and other foreign substances. When ready for use it is deep orange colored, about as heavy as olive oil, and usually somewhat cloudy in appearance. Upon exposure to cold it solidifies. It is said to be employed as an illuminating oil, as well as being used for culinary purposes.

The utility of the dendé palm is not limited to the production of oil. Among the Bahians the leaflets are used for making brooms, while the woody leafstalks are split and woven into baskets.

SOME INTERESTING FRUITS OF RIO DE JANEIRO AND VICINITY.

Aside from the natural beauty of its surroundings, the capital of Brazil has an added interest to the horticulturist in its magnificent avenues of Royal palms (*Oreodora oleracea* Mart.), of which there are a number scattered throughout the city. In such an avenue as that in the Botanic Garden, over half a mile in length, this palm is seen at its best, its straight, flawless trunk rising to a height of over a hundred feet, crowned by a tuft of graceful leaves. There are certainly few plants more striking in landscape effect than this, and it should be more widely grown throughout the Tropics and in the United States wherever it will survive the winters.

Rio de Janeiro does not appear to have the profusion of indigenous and exotic fruits which are found in Bahia, yet the markets are nearly always supplied with many choice sorts. European fruits, such as the apple, the pear, and the grape, hold a much more important position than in Bahia, large quantities being imported from Europe and North America in addition to a limited production of certain ones in various parts of southern Brazil. Many of the tropical fruits found at Bahia are common, notably the cashew, the mango, the sugar-apple, the pineapple, and the banana.

THE JABOTICABA.

Among the fruit trees cultivated in the gardens about Rio de Janeiro the jaboticaba is one of the commonest, and certainly the one which creates the strongest impression upon the newcomer. The

peculiar habit of producing its delicious fruit directly upon the bark of the tree, not only upon the small limbs but upon the trunk and it is said even upon exposed roots, together with the unusual beauty of its symmetrical, dense, umbrageous head of light-green foliage, places it far above the average indigenous fruit tree of tropical and subtropical South America.

The jaboticaba is extremely popular and highly esteemed by all classes of Brazilians. It has been cultivated for generations, yet in spite of this fact, it is, botanically speaking, but imperfectly known. Horticulturists generally list it as *Myrciaria jaboticaba* Berg, but Berg himself distinguished and defined three distinct species, *M. cauliflora*, *M. trunciflora*, and *M. jaboticaba*, whose fruits are all known under the name of jaboticaba. Tavares,¹ in describing these three species, states that they can only be distinguished when growing wild in the forests, since culture produces marked variation from the typical characters and in addition some of the cultivated forms are the results of crosses between the different species. It can easily be seen, therefore, that in studying the trees found in cultivation and attempting to name them accurately, many obstacles are encountered.

The geographic distribution of the jaboticaba is stated by the best authorities to be from Rio Grande do Sul on the south to Minas Geraes on the north and from the coast to Goyaz and Matto Grosso on the west. Outside of this region the tree is occasionally seen in cultivation, as at Bahia, where it does not appear to thrive and is rarely grown. Around Rio de Janeiro it is one of the features of gardens and orchards. Not only are there single trees in many gardens, but occasional small plantations an acre or two in extent.

The zone of the jaboticaba extends from sea level to altitudes of 3,000 feet, or even more. At Petropolis it grows and fruits well, according to Tavares,² and at Barbacena, in Minas Geraes, where the altitude is 1,168 meters, it seems to thrive, although the winters are sometimes very cool. In this section of Brazil, however, ice rarely forms, even at such altitudes.

At Lavras, Minas Geraes, nearly every garden contains one or more trees, making the jaboticaba easily the most important fruit of the region. At Pirapora, head of navigation on the Rio Sao Francisco, there are a few gnarled and stunted trees whose abnormal condition apparently indicates that they are near the edge of the zone in which the tree can be grown.

One of the greatest Brazilian botanists, Barbosa Rodrigues, considered the jaboticaba (Pl. XII) the handsomest of all the Myrtaceae. Under favorable conditions it reaches a height of 35 or 40

¹ Op. cit., v. 10, p. 422.

² Op. cit., v. 10, p. 429.

feet, the trunk branching freely close to the ground. The leaves are persistent, opposite, ovate-elliptical to lanceolate, acute at the apex, generally glabrous, with the margins entire. In length they vary from three-fourths of an inch to over 3 inches, their size being one of the principal characteristics by which the natives distinguish the different horticultural forms which are cultivated in the gardens. The flowers (Pl. XIII) are small, white, produced singly and in clusters on the bark from the base of the trunk to the ends of the small branches, sometimes so thick as almost to hide the trunk, limbs, and small branches from view; in form they resemble those of the myrtle, having four small white petals and a prominent cluster of white stamens. The season of flowering varies greatly with the different species and in different localities.

The fruit (Pl. XIV) develops very rapidly and is ripe two or three months after the appearance of the flowers. In form it is round or slightly oblate, half an inch to an inch and a half in diameter, deep, glossy maroon-purple in color, crowned with a small disk at the apex. While sessile in *Myrciaria cauliflora*, in *M. jaboticaba* the fruits are produced upon slender stems about an inch in length. Those of *M. cauliflora* are considered the largest, frequently averaging an inch or more in diameter as seen offered for sale in the markets. The skin is thick and rather tough; besides coloring matters it contains a large amount of tannin. The translucent, juicy pulp, white or tinged with rose, is of a most agreeable, vinous flavor, suggestive of the Scuppernong or Muscadine grape (*Vitis rotundifolia*) of the Southern States; the whole appearance and character of the fruit so suggest a grape, in fact, as to earn for the jaboticaba the name of "the grape of Brazil." One not infrequently finds a jaboticaba with the disagreeable resinous twang common to a number of myrtaceous fruits. This may be due in many instances to the condition of the fruit at the time of eating or to the inferiority of the particular variety. A good jaboticaba is so thoroughly enjoyable as to tempt one to keep on picking and eating the fruits indefinitely. Brazilians are wont to yield to this temptation, especially the children, who spend hours searching out and devouring the ripe fruits, their only complaint being that it is impossible to satisfy one's appetite with jaboticabas.

The seeds, which vary from one to four in number, are not easily separated from the pulp. In form they are oval to almost round, compressed, and about a quarter of an inch in length.

A number of named varieties are known to the Brazilians, some of which are probably true species, others horticultural forms originating through seedling variation. The name jaboticaba, without any qualifying word, is considered to be properly applied only to

Myrciaria cauliflora. The species jaboticaba is properly known as jaboticaba de Sao Paulo, jaboticaba de cabinho, and jaboticaba do matto. Tavares¹ mentions another species, *M. tenella* Berg, whose fruit is known as jaboticaba macia. The horticultural variety Corôa, one of the commonest named forms in Rio de Janeiro and Minas Geraes, can probably be referred to *M. cauliflora*. Another variety, Murta, is equally well known, and has smaller leaves than Corôa; it, too, is possibly a form of *M. cauliflora*. Branca (white) and Roxa (red) are two other names that are occasionally applied to varieties cultivated in the gardens.

When heavily laden with fruit the tree is a curious and interesting sight (Pl. XV). Not only is the trunk covered with clusters and masses of glistening jaboticabas, but the fruiting extends to the ends of the smallest branches as well. When one stops to consider the comparatively small size of the fruits and the profusion with which they are produced all over the tree, it is apparent that the number must be enormous.

The season not only varies with the species and location, but quite frequently several crops a year are produced. The trees even flower and fruit during the winter months in locations where the temperature does not go below 64° F. Tavares² considers moisture to be the essential factor governing fruit production and states that the fazendeiros (ranchers) of Sao Paulo, who irrigate their trees at times when there is a scarcity of rain, succeed in having ripe jaboticabas throughout the year.

For shipping, the fruit is usually packed in wooden boxes which originally held two 5-gallon cans of kerosene. No packing material is used; and on account of the quantity of fruit in a single package much of it, of course, is crushed and bruised. Since good jaboticabas are sold in Rio de Janeiro for the equivalent of 25 cents a pound there is sufficient profit in handling the fruit to permit its being shipped from considerable distances. Boxes from Sao Paulo and the interior of Minas Geraes are sometimes seen in the markets of Rio de Janeiro.

While the jaboticaba is adapted to a number of different uses, at the present day practically all of the fruit seems to be consumed in the fresh state. By the aboriginal inhabitants a wine was made, which was held in high esteem. Recently the manufacture of jaboticaba jelly has been taken up with very successful results. It has been found that the skins should be removed from about half the fruits used in order to prevent the jelly from having too strong a taste of tannin.

The tree succeeds best in a deep and rich soil, although it seems to grow on heavy clay or poor soils when forced to do so. Its growth

¹ Op. cit., v. 10, p. 429.

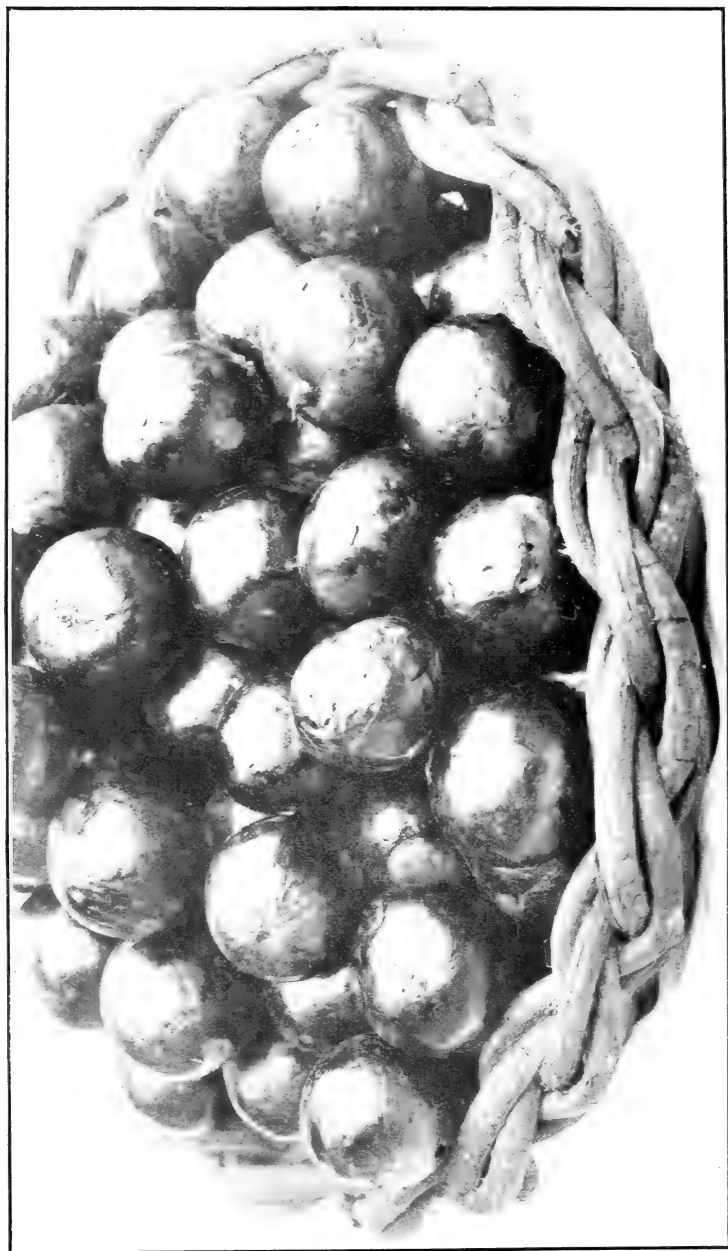
² Op. cit., v. 10, p. 427.



PI 6438FS

SECTION OF A MAIN BRANCH OF THE JABOTICABA TREE IN FLOWER.

The flowers of the jaboticaba are produced directly on the trunk and main branches as well as on the smaller branches and twigs. In one species the fruits are sessile; in another they have short stems. At times the flowers and later the fruits almost hide from view the trunk and large branches and limbs. Photographed at Lavras, Minas Geraes, Brazil, January 20, 1914. (Natural size.)



P14392FS

A BASKET OF JABOTICABAS.

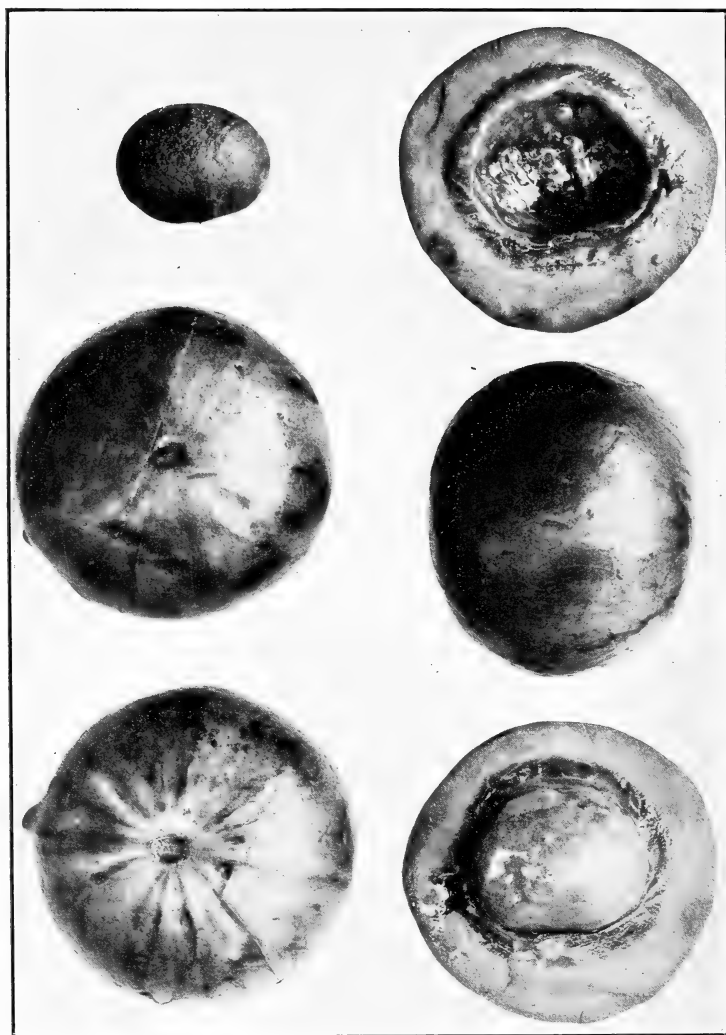
Inclosed by a tough skin is a mass of white, translucent, juicy pulp with one to four medium-sized oval seeds. Their strong resemblance in flavor, character, and general appearance to certain types of grapes has suggested the name "grape of Brazil," by which the jaboticaba is sometimes called. Photographed at Rio de Janeiro, Brazil, October 24, 1913. (Natural size.)



P15123FS

THE FRUITING LIMBS OF A JABOTICABA TREE.

The clusters and masses of glistening purple fruits scattered over the smooth bark of the trunk and main branches of the jaboticaba tree are a novel and interesting sight. Sometimes two or even three crops are produced in a year. Photographed at Sr. Catramby's, Porta d'Água, Rio de Janeiro, Brazil, October 28, 1913.



P16409FS

THE CAMBUCÁ, A NEAR RELATIVE OF THE JABOTICABA.

Like the jaboticaba, this Brazilian fruit (*Myrciaria edulis*) is produced directly upon the trunk and main branches of the tree. It is bright orange in color and of a sprightly, subacid flavor. The tree grows in the forests about Rio de Janeiro and is sometimes seen in gardens. Photographed at Rio de Janeiro, Brazil, January 1, 1914. (Three-fourths natural size.)

is slow, from six to eight years being required for it to come into bearing. While doubtless hardier than many of the strictly tropical fruits, it withstands but little frost. Its advantage seems to be, however, that it thrives in regions where the winters are normally too cool for the successful culture of such fruits as the jak (*Artocarpus integra*) and the cashew, which come from strictly tropical regions.

Its propagation seems to be exclusively by seed, though inarching is said to be practicable. Some vegetative means of propagation must be employed if improved varieties are to be established and perpetuated.

THE CABELLUDA.

This myrtaceous fruit (botanically *Eugenia (Phyllocalyx) tomentosa* Cambess.) is not common in gardens around Rio de Janeiro, although indigenous to the region. While an occasional tree is seen, it does not compare in popularity with either the jaboticaba or the pitanga.

When well grown the tree is handsome and would be of value as an ornamental alone. It reaches a height of 15 to 25 feet, with a broad dome-shaped head of foliage. The leaves are 2 to 4 inches in length and about 1 inch in breadth, oblong lanceolate, bright green and slightly tomentose above, dull green and tomentose below.

The name cabelluda is the feminine of the Portuguese adjective meaning hairy and has reference to the downy tomentum present on both the leaves and the fruits. The tree flowers in June and the fruits ripen in October and November. They are sessile and produced on the small branches in great numbers, somewhat resembling large gooseberries in appearance, but when fully ripe are bright golden yellow in color. The largest specimens are slightly under an inch in diameter, round or nearly so, and the skin is firm and tough. The pulp is rather scanty, but juicy and of pleasant subacid flavor, suggesting the May-apple (*Podophyllum peltatum* L.) of the United States. The one or two large seeds are surrounded with coarse but very short fibers.

THE GUABIROBA.

Another interesting myrtaceous fruit is the guabiropa (*Campomanesia feniziana* (Berg) Glaziov), whose foliage is remarkably similar to that of some of the European oaks. It is indigenous in the forests of Rio de Janeiro State and is cultivated to a limited extent in gardens.

The name guabiropa is also applied, with various orthographical changes, such as gabiroba and guabiraba, to several other fruits of the genus *Campomanesia*, some of which are common on the campos or open plains of Minas Geraes.

The tree occasionally reaches a height of 30 or 40 feet. Its leaves are elliptical-ovate in form, entire, about 2 inches in length, the veins depressed above and prominent below. The fruits greatly resemble small guavas; they are three-fourths of an inch or more in diameter, oblate in form, the apex crowned by a large disk and five persistent sepals. When fully ripe they are orange yellow in color, the surface slightly wrinkled longitudinally and covered with a thick tomentum or down. The skin is thin and surrounds a layer of granular, light-yellow flesh, which incloses the seeds and the soft pulp in which they are embedded. The flavor is similar to that of a guava, but frequently stronger.

According to Tavares¹ there are four varieties of this species, but they are not well known. The principal use to which the fruits are put is the manufacture of jellies.

THE CAMBUCÁ.

Botanically the cambucá is referred to *Myrciaria plicato-costata* Berg, correctly known as *M. edulis* (Vell.) Skeels, but Barbosa Rodrigues believed there was some confusion within the species.

Like the guabiroba, this fruit is indigenous to the vicinity of Rio de Janeiro and is also cultivated in gardens. In general appearance both the tree and the fruit are suggestive of the jaboticaba. The leaves are somewhat larger, however, and the bark a darker shade of brown.

While cauliflorous and sessile, the fruits (Pl. XVI), which are commonly eaten fresh, are not produced in such profusion as jaboticabas, nor are they found as a rule on the lower part of the trunk. In form they are oblate, an inch and a half in length and 2 inches in breadth, with a small brown disk not over an eighth of an inch in diameter at the apex. The skin is smooth, orange yellow in color, and rather tough. The soft, translucent inner flesh only is edible; between it and the skin is a thick, tough layer, bright orange in color, which has to be discarded with the skin. The flavor is subacid, greatly resembling some of the Passifloras, very pleasant and agreeable, though perhaps not so delicious as that of the jaboticaba. The seed is oval, seven-eighths of an inch in length, and is easily separated from the flesh.

THE BACUPARÍ.

This is a beautiful pyramidal tree (*Rheedia brasiliensis* Planch. and Triana) of the family Clusiaceæ, indigenous to the State of Rio de Janeiro. As indicated by the name it greatly resembles the bacurí (*Aristoclesia esculenta* (Arruda) Stuntz; *Platonia insignis* Mart.). It is smaller in size, and while not considered quite so

¹ Op. cit., p. 36, 1913.

delicious is highly esteemed by the natives, especially in the form of a doce or jam, when, as one writer says, "it is a nectar."

In form the bacupari is ovate, rather sharp at the apex, varying in length from an inch and a quarter to an inch and a half. The stem is 1 to 2 inches in length, rather stout. The tough, pliable, orange-yellow skin, about an eighth of an inch in thickness, surrounds the soft, translucent, snowy white pulp in which two oblong, elliptical seeds are embedded. In flavor the pulp is subacid, sprightly, suggestive of the mangosteen, to which it is distantly related. When fully ripe it is delicious.

The tree is said to flower in December and ripens its fruit in January and February. It is little known in cultivation.

THE FRUTA DE CONDESSA.

During March and April the fruta de condessa (*Rollinia deliciosa* Safford) is not rare in the markets of Rio de Janeiro. Large baskets of the fruit are shipped in from the near-by regions and offered alongside its relative, the sugar-apple (*Annona squamosa* L.), called locally fruta de conde, frequently at a higher price than the latter.

In general form this fruit (Pl. XVII) is conical to cordate, sometimes even oblate, and 3 to 4 inches in diameter. The surface is covered with conical protuberances arising from the carpellary areas and is creamy yellow in color. The skin is rather tough and not easily broken; it surrounds the milky white, somewhat mucilaginous flesh in which the seeds are embedded. The flavor is sweet, and it is relished by the Brazilians, as evidenced by the quantity of fruit sold. The seeds are not as numerous as in many other annonaceous fruits and are about the size of an average bean.

FRUITS OF THE HIGHLANDS AND SEMIARID REGIONS OF MINAS GERAES AND BAHIA.

A large number of wild fruits are found on the rolling plains of the State of Minas Geraes, some of them having been brought under cultivation by the inhabitants of this region. In addition to the common fruits of the Tropics, the higher portions of Minas Geraes produce some of the European fruits and the North American grapes quite successfully. As there is an extensive demand for peaches, plums, apples, pears, and other temperate fruits in Rio de Janeiro and other large cities, the Brazilian Government has recently established an experiment station in connection with the agricultural school at Barbacena (Pl. XVIII), where numerous varieties of all the more important temperate fruits are being tested in order to find which are best adapted to the region.

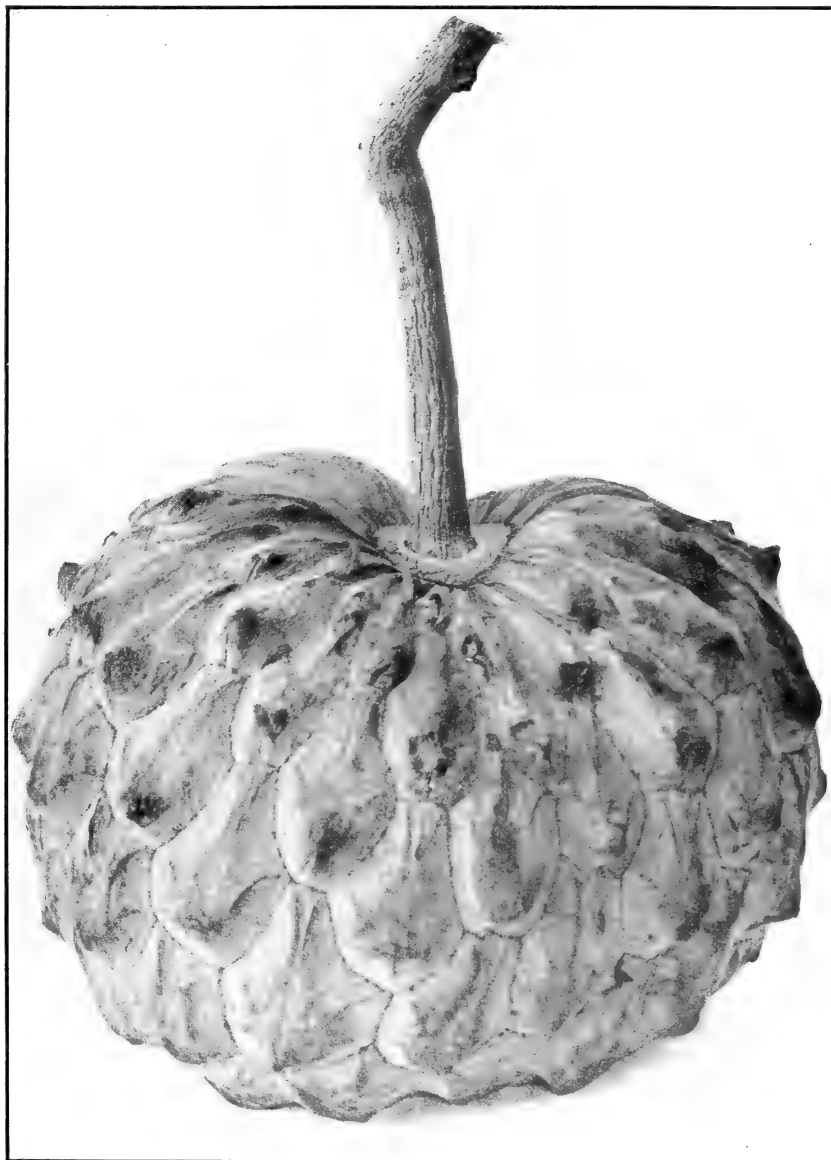
PERA DO CAMPO.

The pera do campo or cabacinha do campo (pear of the campo or gourd of the campo; botanically *Eugenia klotzschiana* Berg) is found near Lavras, Minas Geraes, and also at Sitio, about 100 miles east of Lavras; but it is extremely rare in both places and the natives themselves in many cases seem not to be familiar with it. The plants usually grow in groups or patches and are so low that it is often difficult to distinguish them among the grass. The aromatic, penetrating odor of the fruits, however, which is noticeable several yards away, frequently furnishes a clue to their location.

The plant is not bushy or shrubby in growth, but usually sends up several slender, unbranched stems 1 to 2 feet in height. When growing along the banks of ravines this habit is sometimes changed, the stems attaining a height of 4 or even 5 feet and giving rise to a few slender, drooping lateral branches. The leaves are lanceolate, 3 to 5 inches long, rather hard and brittle, silvery pubescent on the under surface. The slender pyriform fruits, 2 to 4 inches in length, ripen from November to January. In appearance they somewhat resemble pears except in their more elongated form and downy surface (Plate XIX). The thin, delicate skin is light yellow to golden brown in color. The flesh resembles that of a pear in color and texture; it is extremely juicy and possesses a strong aromatic fragrance indicative of its flavor, which is acid, spicy, and refreshing. Little is known of its uses, but it is probably better suited to culinary use than for eating fresh, because of its acidity and a possible slight purgative effect. The seeds, one to four in number, are irregularly oval in shape and occupy a comparatively small amount of space in the center of the fruit, a rather unusual thing in a wild species of *Eugenia*.

LIMÃO DO MATTO.

The limão do matto (lemon of the forest; *Rheedia edulis* Planch. and Triana) is a rare fruit, cultivated to a small extent at Lavras, Minas Geraes. The tree is small, upright, sometimes pyramidal in form, of handsome appearance, with its oblong, glossy, deep-green leaves 4 to 6 inches in length. The fruit (Pl. XX) is about 2 inches long, usually elliptical, tapering at both ends, and bright orange in color. The thick, tough skin incloses a mass of light-colored, juicy, aromatic pulp of rather acid flavor. The seeds vary from one to three in number and are oblong or oval in form, about an inch in length. If cut or bruised, a viscous, bright-yellow fluid exudes from them. In quality, the fruit of this species seems slightly inferior to *Rheedia brasiliensis*, which grows at Rio de Janeiro.



THE "COUNTESS'S FRUIT" (FRUTA DE CONDESSA).

P14993FS

This popular fruit (*Rollinia deliciosa*) grows wild near Rio de Janeiro. It is picked while still hard and green and brought into the markets, where it gradually assumes a bright-yellow color and becomes soft. It contains numerous dark-brown seeds about the size of an average bean, each surrounded by milky white flesh, which is sugary sweet and of good flavor. Photographed at Rio de Janeiro, Brazil, March 16, 1914. (Natural size.)

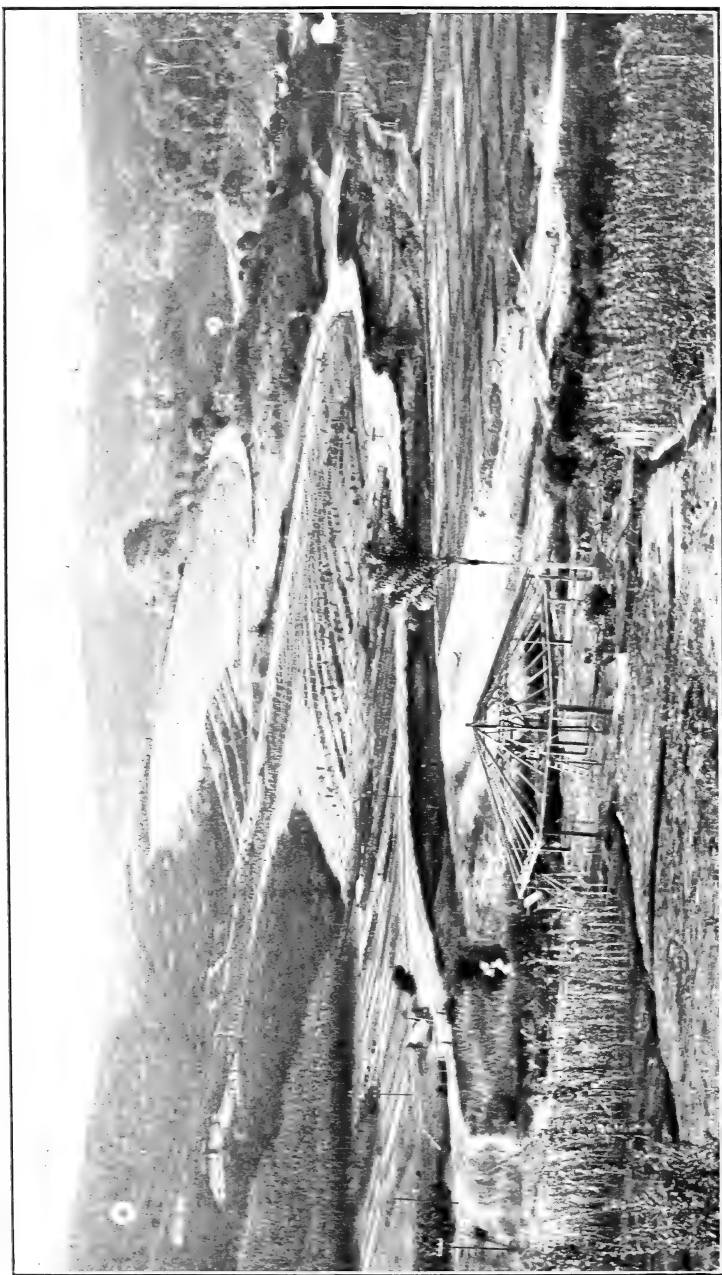


PLATE XVIII

GOVERNMENT AGRICULTURAL EXPERIMENT STATION AT BARBACENA, BRAZIL.

This experimental farm is maintained in connection with the Aprendizado Agricola, a government agricultural school, the main building of which is visible on the distant hilltop. As the climate of this region is somewhat temperate, due to its 3,600 foot altitude, the cultivation of a number of Temperate Zone fruits is possible. Extensive varietal tests and acclimatization work are in progress. Photographed January 29, 1914.



PI1644FS

THE PERA DO CAMPO (EUGENIA KLOTZSCHIANA), A SPICY FRUIT FROM THE CAMPOS OR ROLLING PLAINS OF SOUTHEASTERN BRAZIL.

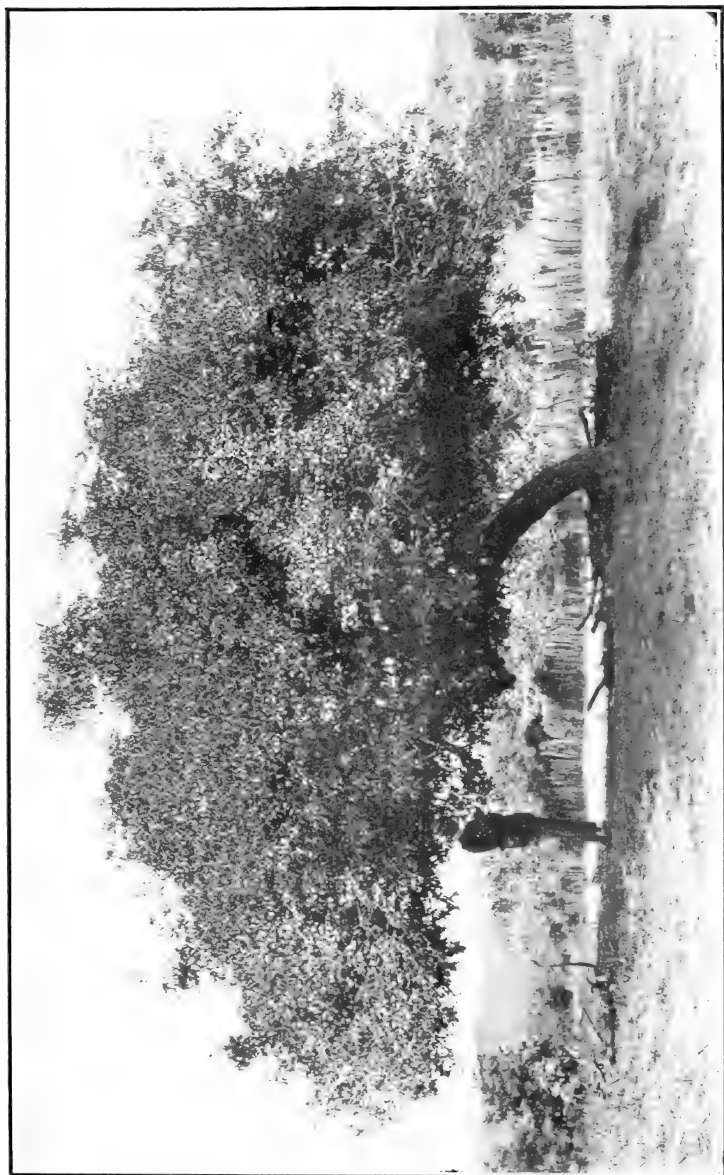
This little-known fruit is called *pera do campo* (pear of the campo) or *edacinha do campo* (gourd of the campo). Its flesh is white, melting, very juicy, acid, spicy, and refreshing. It possesses such a pleasant aromatic fragrance that the fruit can frequently be scented on the campo before the plant is seen. The seeds are small in proportion to the size of the fruit, a rather rare occurrence in a wild *Eugenia*. Photographed at São Paulo, Minas Gerais, Brazil, January 29, 1914. (Natural size.)



P19428PS

THE LIMÃO DO MATTO ("LEMON OF THE FOREST").

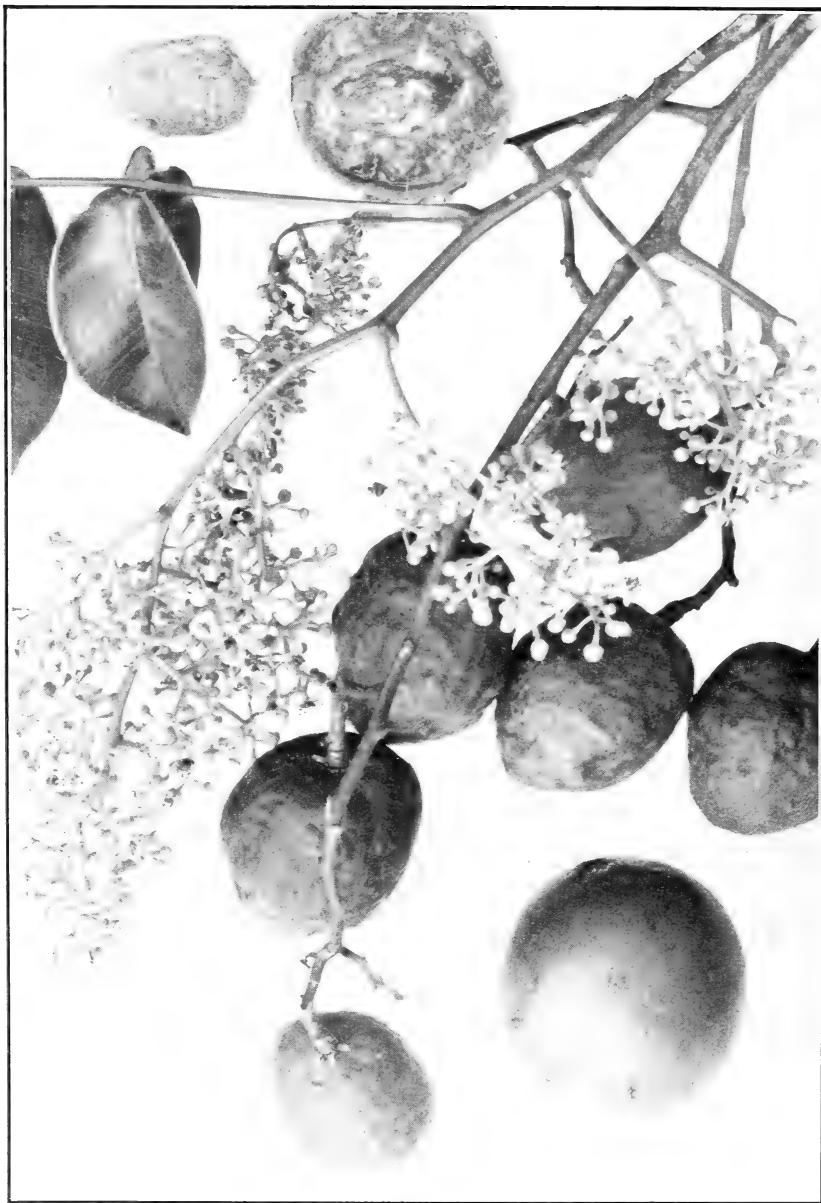
A handsome small tree (*Rheedia edulis*), with striking dark-green foliage. The attractive, medium-sized, round or oblong yellow fruit somewhat resembles a lime or small lemon. When fully ripe, the light-colored juicy pulp loses most of its acidity, has a pleasant flavor, and is slightly aromatic. The tree is related to the mangosteen. Photographed at Lavras, Minas Geraes, Brazil, January 12, 1914. (Natural size.)



P14830FS

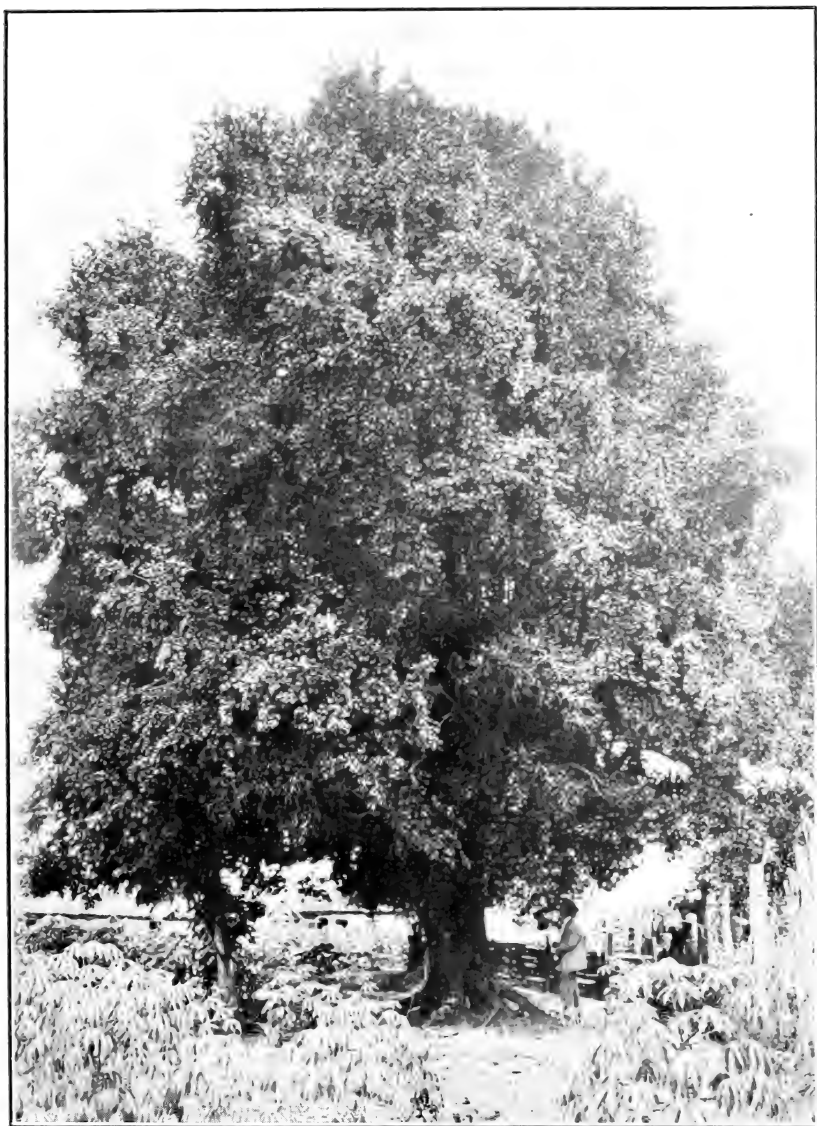
THE IMBÚ TREE (*SPONDIAS TUBEROSA*).

Among the native plants on the caatingas or dry lands of the State of Bahia, few are of greater importance to the people than the imbú tree, the fruit of which forms an important article in their dietary. It is not often cultivated, the wild trees apparently being sufficiently abundant to supply the inhabitants of the small interior towns with all the fruit they can consume or dispose of. Photographed at Brejo, Minas Geraes, Brazil, February 14, 1914.

FLOWERS AND FRUITS OF THE IMBÚ (*SPONDIAS TUBEROSA*).

P14511FS

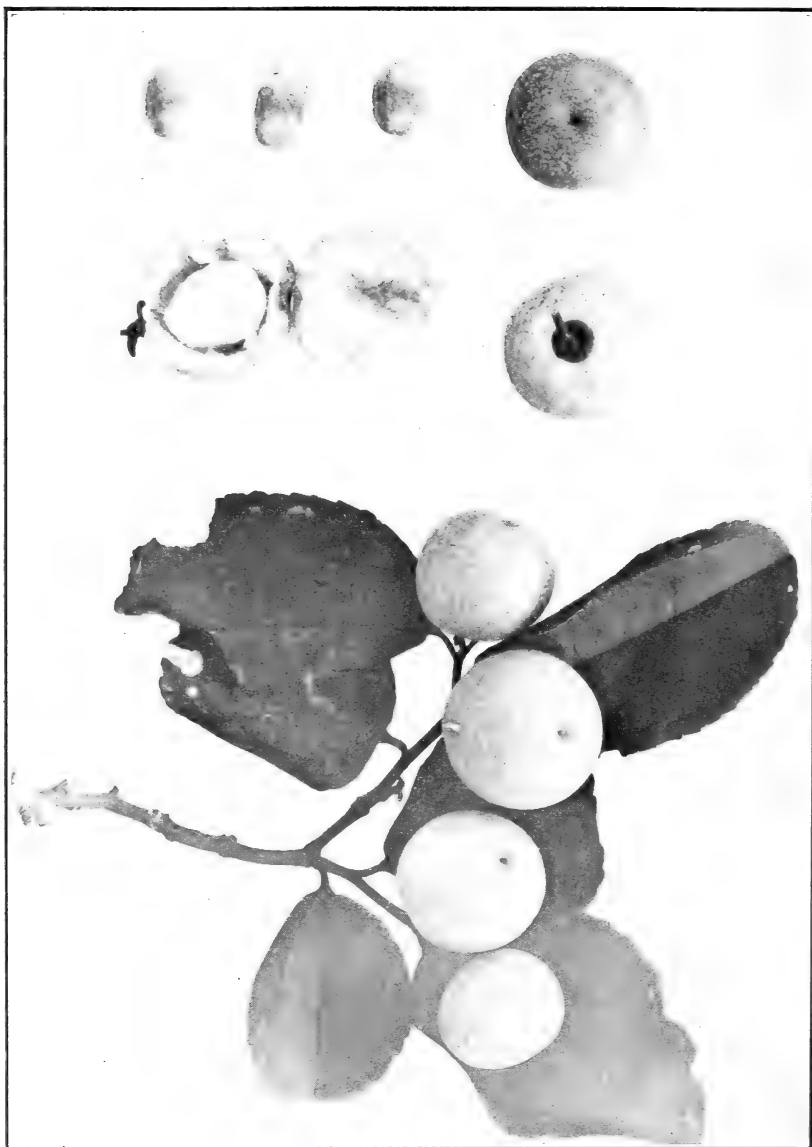
The thick yellow skin of the fruit incloses a juicy pulp of a subacid flavor, somewhat suggestive of a sweet orange. The natives, in addition to eating quantities of the fresh fruit, make imbú jelly and a famous Brazilian dish called imbudada, prepared by mixing the juice of the imbú with boiled sweet milk, sweetened to taste. This is a delightfully pleasant and refreshing drink, not altogether unlike whipped clabber with sugar, except that it has a decidedly fruity flavor. Photographed at Bahia, Brazil, December 15, 1913. (Natural size.)



PI4839FS

THE JOAZEIRO (*ZIZIPHUS JOAZEIRO*), AN INTERESTING DRY-LAND TREE.

This is a handsome evergreen tree, with dense green foliage and is said to be the only plant on the caatingas which retains its foliage through the long season of drought. The fruit (called *jua*) and foliage are eaten by stock. Photographed at Brejo, Minas Geraes, Brazil, February 14, 1914.



FRUITS AND FOLIAGE OF THE JOAZEIRO.

P14777FS

The numerous small green fruits, about the size of a cherry, which become yellow when ripe, have a translucent, viscous pulp surrounding the seeds, which is eaten by the lower classes of natives; but its peculiar, insipid flavor is not particularly agreeable to the average person. As the fruits are produced in the greatest abundance and are eaten by stock, they have more or less economic importance in regions subject to excessively dry periods. Photographed at Januaria, Minas Geraes, Brazil, February 13, 1914. (Natural size.)

THE SUGAR-APPLE.

In the small towns throughout the interior of Minas Geraes and Bahia States the sugar-apple (*Annona squamosa* L.) is one of the most important cultivated fruits. It is known here as pinha (pine cone; probably so called because of the similarity in appearance). Originally brought to the interior from Bahia, it is believed, the tree found such congenial surroundings and produced fruit of such excellent quality that it has gradually taken first place in many gardens. The fruit is peddled about the streets by small boys, large specimens selling for 2 vintens (less than 2 cents), smaller ones for a vintem.

In flavor the sugar-apples of this region are superior to those of the coast. They are not so large as those of Bahia, but there is a peculiar delicacy of flavor and tenderness of flesh which is lacking in the latter place. This may be due in part to the fact that the fruits are allowed to remain on the tree until fully ripe, while at Bahia they appear to be picked a trifle too soon and are then ripened in the house.

A good sugar-apple is 3 inches in diameter and usually heart shaped. Within its rough exterior is a mass of snow-white delicately flavored pulp containing numerous black seeds the size of a bean. The pulp separates into slender, conical segments, each one containing a seed. After being picked from the tree the fruit is placed in a cool place for 24 hours, when it becomes soft and ready to eat. It is always eaten while fresh, no methods of cooking or preserving it being known.

THE SWAMP ARATICUM.

Near the village of Urubu, on the Rio Sao Francisco some distance below Januaria, the low, swampy lands which extend back from the river bank a distance of three or four hundred yards are covered with *Annona spinescens* Mart., a compact, spiny shrub known to the natives as araticum do brejo, or "swamp araticum." This plant is often found on ground which is submerged under a foot or two of water during part of the year. It grows to a height of 8 or 10 feet and produces an abundance of oblong-conical fruits 2 to 3 inches in length, reddish orange in color and externally covered with small conical protuberances. When fully ripe, these fruits are so soft and delicate in texture that it is difficult to handle them without breaking the skin. The flesh is of the same color as the exterior and of a sweet, insipid flavor, apparently not relished by the natives, as they allow the hogs to consume the crop. The seeds are very numerous and do not separate easily from the pulp. The spe-

cies may prove valuable, however, as a wet-land stock for the cherimoya or for breeding purposes.

THE IMBÚ.

Among the drought-resistant plants of the caatinga or semiarid section of interior Bahia, the imbú (*Spondias tuberosa* Arruda) is of particular interest. It is abundant and highly appreciated, not only in the interior of Bahia State, but also in Pernambuco and other sections of northeastern Brazil. To the natives it is a most important article of diet, taking the place of the cultivated fruits which are so common around the city of Bahia, but in the interior found only in the gardens of the better classes. During the ripening season imbús may be had for the gathering. Natives go out from every village into the surrounding caatinga, often to a distance of several miles, and bring in bushels of the fruit on their burros or diminutive ponies, consuming much of it immediately, but not forgetting to store away an abundance in the form of jam or jelly for the time to come when the imbú can not be obtained. In all the towns and villages along the Rio Sao Francisco, in Bahia State, imbús are plentiful in the markets, and the ground around the market places is often literally covered with the skins and seeds. A basket containing a quarter peck or more of the fruit can usually be purchased for 2 or 3 cents.

The imbú tree (Pl. XXI) is distinguishable from other growths on the caatinga by its low, spreading head, sometimes 30 feet in diameter. Its fruit is produced on slender stems, mainly toward the ends of the branches. Some trees are so productive that the fruit, when allowed to fall, forms a carpet of yellow upon the ground.

In general appearance the imbú (Pl. XXII) may be likened to a greengage plum. It is oval, about an inch and a half in length, slightly less in breadth, and light greenish yellow when ripe. The skin is somewhat thicker than that of a plum, with the result that it is not eaten along with the pulp. The flavor of the soft, melting, almost liquid pulp is suggestive of a sweet orange. It is frequently eaten before fully ripe and soft, when it is rather acid, though not disagreeably so. The seed, oblong and about three-fourths of an inch in length, is difficult to separate from the inner pulp which adheres to it.

The natives of the interior will often tell one that there are several varieties of the imbú, one being round, another oblong, and so on. The fact is that seedling variation results in the fruit of every tree being different from its neighbors in some minor characteristic of size, form, or flavor. No doubt the fruit could be greatly improved by selection, even in a few generations.

The imbú furnishes the basis for a dish famous throughout north-eastern Brazil, known as imbuzada. This is made by adding the juice of the fruit to boiled sweet milk. The mixture is greenish white in color and when sweetened to taste is relished by nearly everyone on first trial. Imbú jelly is another well-known product, obtainable in the stores of Bahia, Rio de Janeiro, and other coastal and interior cities.

THE JOAZEIRO.

Another interesting tree of the caatingas is the joazeiro, or juazeiro (*Ziziphus joazeiro* Mart.), from which the town of Joazeiro takes its name. This tree grows along the banks of the Rio Sao Francisco in Bahia State, but is not abundant in most parts. It rarely occurs in large groves, but is usually scattered among the other plants along the river and on the caatinga. When it attains mature size it forms a beautiful, dark-green, umbrageous head 30 feet in diameter (Pl. XXIII). The leaves are hard and brittle in texture, oval to ovate, about 2 inches in length. The small wood is armed with short, stiff thorns, which are not, however, particularly dangerous.

The fruits (Pl. XXIV) vary greatly in size according to the tree by which they are produced. The largest ones are nearly an inch in diameter, round, and creamy yellow in color. Inside the thin skin is a layer of mealy flesh, within which lies the seed, surrounded by a mass of translucent, mucilaginous pulp. In size and shape the seed resembles a small olive stone. The pulp adheres to it very closely and can scarcely be separated, even in the mouth. The flavor is peculiar and somewhat insipid.

Natives of the poorer classes gather up the fruit and use it for food, but it is as a source of stock feed in dry regions that the tree seems to have its greatest value. The trees bear prodigiously, the ground under them being covered with fruits at the end of the season. These are considered fattening and reported to be readily eaten by cattle and swine. In addition, the ornamental value of the tree and its drought-resisting qualities make it worthy of note. It is said to be the only plant on the caatinga which retains its leaves during excessively dry periods.

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